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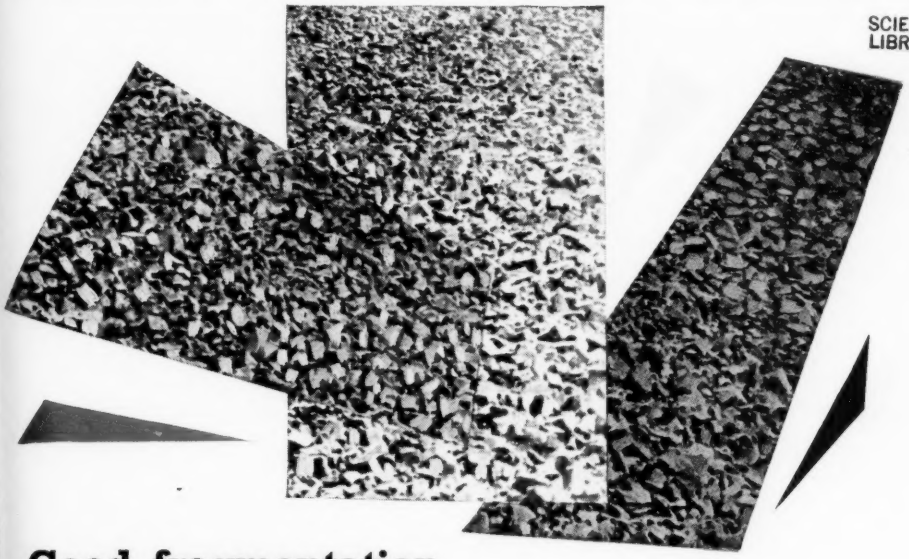

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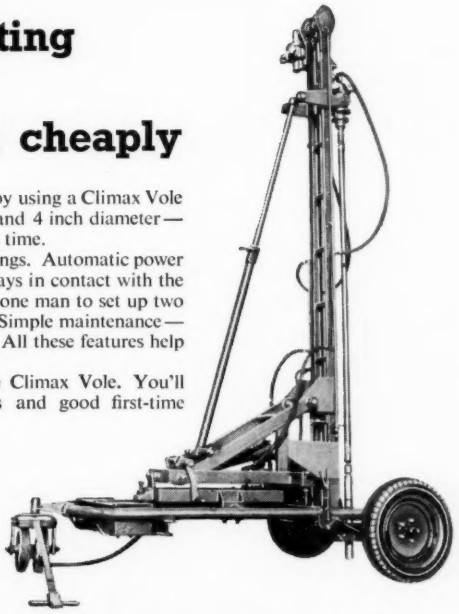

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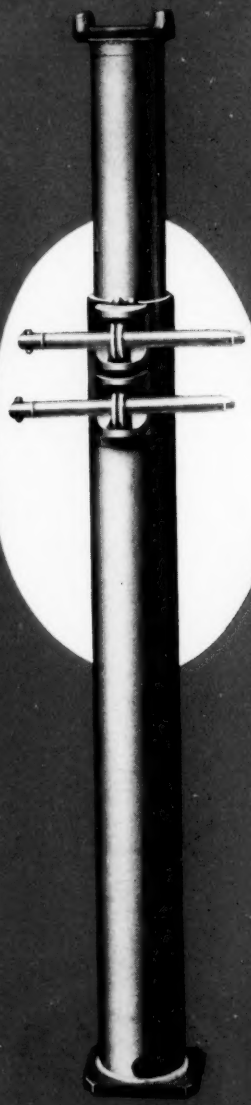

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CONTENTS

EDITORIAL

SKINNER'S "Mining Year Book," [1] now in its 72nd year, made its welcome appearance last month. As usual it provides complete and up-to-date particulars of some 945 companies operating in all parts of the world, giving, in addition, a list of the names and addresses of 1,220 mining engineers and managers and the companies with which they are connected. The usual tables and guide sections continue to add to the usefulness of this comprehensive work.

THE European Atomic Energy Community has been notified of the British Government's intention of accrediting Sir William Meiklereid as its representative on the Commission. Sir William at present heads the U.K. delegation to the High Authority of the European Coal and Steel Community. Agreement on co-operation between the United Kingdom and the Community in the field of the peaceful use of atomic energy is also urged.

HELD on May 9, the Camborne School of Mines dinner provided the usual cheery function, many county educationalists and other dignitaries as well as representatives from other institutions being present on the occasion. Following the loyal toasts Mr. G. Keith Allen proposed "The Institution of Mining and Metallurgy," of which, of course, he was then president, going on to speak of the work which that body is doing to further the interests of the profession. Mr. Allen, referring to modern advances in mining practice, many of which he had seen in recent visits to the continent, was well content that the School had so many younger men coming along to serve the industry.

AN exhibition of mining machinery is planned to be held at Olympia, London, next year. This is being organized by the Council of Underground Machinery Manufacturers to take place from July 9 to 18, who point out that it is now ten years since the Council last held such an exhibition and that there have been a number of interesting developments both in the design and utilization of the equipment used in mining in the interval. It is understood to be the intention to invite exhibits from firms who are not members of the association and thus to be hoped that the scope will be somewhat wider than on the previous occasion. A symposium on shaft sinking and tunnelling, arranged by the Institution of Mining Engineers to run for three days during the period of the exhibition, will be an added attraction.

[1] London: Walter E. Skinner and the *Financial Times*. Price 42s. 6d., post free.

THE new president of the Institution of Mining and Metallurgy, Mr. J. B. Dennison, whose career was briefly reviewed in the MAGAZINE for November last, was inducted to the chair following the annual meeting last month and delivered the customary address, his subject being productivity. This was a matter, he felt, which would interest all branches of the industry, even if, at first, it meant different things to the miner, metallurgist, geologist, and mineral dresser, and he went on briefly to review the course of events in various branches of mining, comparing rising costs with rising efficiency. In turn he spoke of gold mining in South Africa and Ghana and of tin mining in Malaya, drawing a general conclusion that while there seemed to be a steady rise in production costs at 4% a year productivity seemed generally to lag behind that figure. Nevertheless, it was his view that such ideal figures must be the goal if industry was to be kept on an even keel. While, the president said, members of the Institution were not usually in a position where work results could be measured or costed directly, he thought that all could measure their work in the productivity sense and be "continually on the look out for ways and means of doing more work in less time and eliminating the non-essential." Experience has shown, Mr. Dennison said, that "anything of this nature involves less effort, too."

Non-Ferrous Metals Research

The latest report of the British Non-Ferrous Metals Research Association, which became available last month, fittingly records the useful expansion in income and work carried out which has become possible in the last two years. All the available space in the existing buildings in London has now been brought into use, while the erection of a new building in Euston Street is well advanced. This is expected to provide more laboratory

accommodation tailored to the Association's special requirements and greatly to aid in the efficient use of an expensive London site. It is stated that income from industrial members and total revenue income each increased between 1955 and 1957 by about 25%, apart from generous extra contributions which will largely pay for the new building. With the facilities becoming available new lines of research are to be undertaken in the field of nuclear energy, instrumentation, and the fatigue of structures, at the same time providing urgently-needed extra space for the existing work of the various sections of the research department.

Serving as it does the smelting, manufacturing, and using industries dealing with all the main non-ferrous metals the Association has an extremely varied programme and no less than 46 researches are listed in the report. In the extraction and refining laboratories, for instance, a method has been developed to get rid of lead and tin when fire refining copper, particularly wire and cable scrap, and this has halved the furnace time while reducing the amount of copper entering the refining slag from about 5% to about 1½% of the charge weight. In the new foundry a fresh survey of furnace operating economics has been carried out, fuel costs, melting losses, and metal quality being studied in a number of foundries using a variety of furnaces. The survey has enabled some of the important criteria in the selection and operation of furnaces to be more clearly defined. All departments, it is thought, are proving their worth and providing a wealth of information and advice to metal users in industry.

Mention might also be made and attention drawn to the work of the Information Department of the Association and its valuable library. These feed published information to members on a liberal scale, while the Liaison and Technical Service Department gives members individual and confidential advice on specific problems and tries to ensure that new scientific knowledge is widely applied. Getting research results across to industry, it is concluded, is of the greatest importance and some of the methods used were displayed in an exhibit at the reception which preceded the annual luncheon.

Rare Earth Centenaries

Referring to the review of the economic geology of the rare-earth minerals by Professor Heinrich, of the University of Michigan, which appeared in the May issue, a correspondent draws our attention to the fact that the current year is of particular interest in that two " rare earth centenaries " are due to be commemorated. It is just 100 years ago on October 15 that Gustav Mosander, pharmacist and army surgeon, who became professor of mineralogy and chemistry at the Caroline Institute in Stockholm and curator of the mineral collections at the Academy of Sciences, died. That loss to rare-earth chemistry, however, was offset by the birth of Carl Auer von Welsbach, on September 1, 1858, a genius destined to further the practical application of the rare earths. With Mosander discovering lanthana and didymia and with Welsbach splitting didymia into praseodymia and neodymia and also pioneering thoria and ceria to the point of their use in gas mantles and lighter " flints," this double centenary falling in 1958 is worthy of note.

Mosander was a medical man who lived with Berzelius for a time and also worked with Wöhler, in his Stockholm period ; a man to whom chemistry became more interesting than medicine. It should be remembered that before Mosander took to rare earths the yttria discovered by Gadolin and ceria were thought to be single earths or oxides, although with both earths attracting the studies of Boisbaudran, Mosander, and others the full story was yet to come. Mosander chlorinated an alkaline suspension of so-called " cerium " hydroxide and obtained a yellow residue believed to be ceria and a solution containing what he considered lanthana, a new single earth element. From " cerium " nitrate he obtained similar results on extracting the residue, but on igniting the earths separated he arrived at a brown sample of lanthana which he considered should have been white if pure. By 1841 he extracted his brown lanthana with dilute nitric acid and separated two components—the expected white lanthana and a red earth he called " didymia." " Lanthana " meant " hidden " and when lanthana was found in a Norwegian mineral later this mineral was appropriately named " mosandrite." " Didymia " got its name from being " an inseparable twin of lanthana," a name objected to by other chemists, although it remained so until Welsbach in 1885 separated it into neodymia and praseodymia. Incidentally, these names of rare earths perpetuate the name of Ytterby, near Stockholm, where a black

mineral rich in such earths was found, rather than commemorating the discoverers. Thus ytterbium, yttrium, erbium, and terbium of to-day are all variants of " Ytterby."

Turning now to Auer von Welsbach, it would be difficult to find a superior among chemists distinguishing themselves in both the pure science and in invention. He was born in an appropriate year, when the spectroscope was turned to chemical use, to prove a boon to rare-earth studies when Gladstone adapted it. Mosander had passed on leaving some controversy over the naming of other rare earths he suspected present in his " yttria." The " erbia " and " terbia " he had found in the fractions were names regarded with suspicion until terbia was obtained, first in 1878 and then by Urbain in 1905. In contrast the further study of Mosander's didymia by Welsbach resulted in 1885 in his separation by repeated fractionation of ammonium didymium nitrate into two earths—praseodymia and neodymia. He had removed the earth samaria from his impure didymia before this painstaking separation and named " green didymia," which gave green salts, " praseodidymia " at first, this being simplified to " praseodymia " just as his " neodidymia," yielding red salts, became " neodymia." Welsbach, born in Vienna, was fortunate in going to Heidelberg to study under Bunsen who had just invented his famous burner and used it to give flame tests and set Welsbach to extend his small collection of rare earths.

It was not only in pure chemistry, however, that Welsbach was to become eminent. In 1880 he noted how erbia gave green rays, an observation which sent him to study the spectra of earths in a period following when Bunsen and Kirchoff were making history in using the spectroscope. When experimenting on beads of test material held on a platinum wire, as in normal flame tests, he found they gave a poor source of radiation ; hence Welsbach used cotton threads soaked in a solution of the rare-earth salt. On calcining such threads impregnated with lanthana there resulted a much brighter light source ; so came his further experiments leading to the use of thoria containing 1% ceria giving a brilliant glow or incandescence, this leading to the Welsbach gas mantle. Welsbach gave a demonstration in Vienna to the Press, receiving favourable reports in some cases and adverse in others. He went on to fashion a fabric to suitable shape, sewed together at one end with fine platinum wire at first, and proved that a coherent skeleton of ash from his famous " Auer Mixture " of rare earths was practical.

The rest of the Welsbach story reads like so much fiction, with the one-time star pupil of Bunsen going on to fame and fortune. He became Baron von Welsbach, told the Emperor Franz Josef that he had found employment for more than 40,000 people as a result of his discoveries, and when he retired to Welsbach Castle in the Carinthian Alps had his spectroscope, his laboratory, and his unrivalled collection of rare earths guarded by his faithful terrier ! His patents were supreme despite other workers who made spurious efforts to avoid paying for them by claiming the use of such (very) rare earths as " russium," " kosmium," and " neokosmium." Then came his other striking successes, the first being his iron-cerium alloy which found an everyday application for crude ceria, at that time a drug on the market. It was while wandering around a factory yard that he began to study this problem of dumps of ceria in gas-mantle factories in times when manufacturers gave away 1 lb. of ceria with every 100 lb. of thoria purchased. The first lighter flints of pyrophoric alloy were not brittle enough to emit sparks efficiently ; yet Welsbach's patents of 1903 solved this problem of utilizing " misch-metal " in iron-cerium alloys with up to 35% cerium. Gas mantles and automatic gas lighters (and to-day Mr. Everyman's petrol lighter) were not all that Welsbach gave the world to justify his motto of *Plus Lucis*. For he next turned to osmium, that element of the platinum group discovered by Smithson Tennant which also seemed destined to become a drug on the market as by-product of platinum extraction. In his search for electric lamp filaments Welsbach had coated platinum wire with thoria as a link with his rare-earth studies and a hint at thoriated filaments to come. Then he turned to osmium with its high melting point but toxic oxide, a metal which before tantalum and then tungsten banished it was to prove suitable for filament making. With no powder metallurgy technique available Welsbach used the squirting process with metal powder *plus* cellulose binder ; one which gave brittle filaments yet which had its day, since burned-out osmium lamps were reclaimed to offset the high price. The Osram lamp of 1906 incorporating an osmium-tungsten alloy was the final result of Welsbach's third inventive period.

MONTHLY REVIEW

Introduction.—Labour troubles continue to weaken business confidence and markets generally proceed with caution. For instance, the dock strike may by this time be interfering seriously with supplies of metals to industry. It is considered that further relaxation of the credit squeeze may soon be forthcoming in order to revivify those sections of business now feeling the effects of "recession" conditions.

Transvaal.—The output of gold from the Rand and O.F.S. mines for April was 1,401,094 oz. and that from outside mines 38,352 oz., bringing the monthly total to 1,439,446 oz. At the end of the month there were 337,284 natives at work on the gold mines, as compared with 333,862 at March 31.

The accounts of STILFONTEIN GOLD MINING for 1957 show a profit of £4,700,966 and £5,233,743 available, of which dividends equal to 2s. 10½d. a share require £1,877,794. In the year 1,231,000 tons of ore was milled and 564,607 oz. of gold recovered, while the uranium plant produced 334,975 lb. of uranium oxide. At December 31 last the ore reserves were estimated as 4,361,000 tons averaging 9·94 dwt. in gold and 0·321 lb. uranium per ton. It is stated that modifications to the headgear of the Margaret shaft are in progress for the housing and installation of a koepe winder to provide additional hoisting capacity to meet the planned increased scale of production.

MODDERFONTEIN B GOLD MINES reports a profit of £30,258 for 1957, a credit balance of £220,481 being carried forward. Operations are now confined to reclamation, but in the year under review 9,563 oz. of gold was recovered from 59,196 tons of ore crushed.

The operations of DURBAN ROODEPOORT DEEP for 1957 resulted in a profit of £560,745, the accounts showing £1,365,394 available, of which dividends equal to 3s. a share required £348,750. In the year the 2,192,000 tons of ore crushed yielded 387,188 oz. of gold. Available ore reserves at December 31 last were estimated as 7,760,000 tons averaging 4·0 dwt. in value over 59·7 in.

The report of SIMMER AND JACK MINES for 1957 shows a profit of £289,896 and a total of £340,111 available, of which dividends equal to 10d. a share absorbed £281,250. The mill dealt with 1,151,000 tons of ore in the year and 213,933 oz. of gold were recovered. Reserves at December 31 last are given as 840,000 tons averaging 4·2 dwt. in value over 45·2 in.

RIETFONTEIN CONSOLIDATED MINES reports a profit of £200,242 for 1957, the accounts showing £233,280 available, of which dividends totalling 2s. 2d. a share require £121,577. The 290,500 tons of ore crushed yielded 67,787 oz. of gold. At the end of the year the ore reserves were calculated to be 194,000 tons averaging 5·0 dwt. in value over 49·1 in.

The accounts of ROBINSON DEEP for 1957 show a profit of £162,360 and £314,493 available, of which dividends equal to 1s. 3d. a share absorbed £125,000. In the year 908,500 tons of ore was treated and 187,253 oz. of gold recovered. The ore reserves are given as 1,338,000 tons averaging 4·5 dwt. in value over 54·7 in.

At the recent annual meeting of NIGEL GOLD MINING a resolution was passed reducing the issued capital from £359,817 5s. to £215,890 7s. After confirmation by the Court of the reduction of capital a circular is to be issued advising shareholders of the date on which the return of 2s. per share in cash will be made.

Last month the directors of RUSTENBURG PLATINUM MINES announced that, in order to meet competition from other sources, the price of platinum sold on behalf of the company has been reduced in the United Kingdom from £25 15s./£26 15s. to £24/£25, and in the United States of America from $72/$75 to $67/$70. The re-organization of operations at the mines of the company has been completed and production is now at a level somewhat lower than the presently estimated volume of sales during the current financial year, which remains at approximately 50% of that achieved during the financial year ended August, 1957. It is hoped that existing stocks of platinum will now gradually be reduced.

The WEST RAND INVESTMENT TRUST reports a profit of £1,712,156 for 1957, £1,524,870 of the £2,058,589 available being required for dividends totalling 3s. a share. The ANGLO AMERICAN INVESTMENT TRUST made a profit of £3,093,844 and paid out £2,650,000 in dividends, equal to 17s. 6d. a share with a bonus of 2s. 6d.

EAST RAND CONSOLIDATED reports a profit of £62,866 for 1957. Of the £85,479 available

a dividend equal to 1½d. a share absorbs £21,652.

Orange Free State.—Last month shareholders of HARMONY GOLD MINING were informed that, in pursuance of engagements entered into in early 1957, arrangements have now been concluded between the South African Atomic Energy Board and the United Kingdom Atomic Energy Authority, a partner in the Combined Development Agency, for the sale of 1,500 tons of uranium oxide to be produced by the Harmony company between 1958 and 1966, a quantity additional to that which Harmony will supply to the South African Board for sale to the Combined Development Agency under the arrangements announced by the Minister of Mines on May 8, 1958. After a thorough review of the output of the existing plant in relation to the improved grade of uranium ore now becoming available in the No. 2 shaft area of the mine, it is considered that the above commitments can be met without addition to the uranium plant and it has therefore been decided not to proceed with the installation of the fourth unit of the uranium plant. Work on the extension of the gold plant is proceeding as planned.

Shareholders of PRESIDENT BRAND GOLD MINING are advised that since the special and ordinary resolutions were passed at the extraordinary general meeting held on June 3, the nominal capital of the company has now been increased from £3,250,000 to £3,510,000 by the creation of 1,040,000 shares of 5s. each. As already indicated the new shares are to be offered to members, the consent of the United Kingdom Treasury having been received to the issue of such portion of the shares as may be subscribed in Great Britain.

The report of the ORANGE FREE STATE INVESTMENT TRUST for 1957 shows a profit of £1,397,089 and £1,646,333 available, of which dividends equal to 3s. a share require £1,401,839.

Diamonds.—In his statement accompanying the report and accounts of DE BEERS CONSOLIDATED MINES for 1957 the chairman, Mr. H. F. Oppenheimer, says that mining operations by De Beers, the CONSOLIDATED DIAMOND MINES, and the PREMIER companies were conducted on a similar scale to 1956, but the mine at Kleinzee, in Namaqualand, was exhausted. A satisfactory lease has been negotiated over portion of the adjoining farm Kleinzee Annex and prospecting operations are now being conducted there. Negotiations between the company and the Union Government to provide for the prospecting of all the other potentially diamondiferous farms in the Namaqualand and Van Rhynsdorp districts are said to be in an advanced stage. At Kimberley there have been important technical innovations, including the introduction of block caving at the Dutoitspan and Bultfontein mines and the provision made for hoisting ground from these two mines from a common shaft. In addition, the erection of a modern treatment plant at a cost of £1,500,000 has just been completed.

During 1957 PREMIER (TRANSVAAL) DIAMOND MINING treated 5,347,878 loads of ground and recovered 1,399,976 carats of diamond. The company's accounts show a profit of £1,208,942.

The report of the CONSOLIDATED DIAMOND MINES OF SOUTH-WEST AFRICA for 1957, which shows a profit of £14,974,986, says, regarding treatment, that the main plants operated satisfactorily during the year, but, although the 48 in. diameter secondary H.M.S. cone was successful in reducing the quantity of concentrates, it was found to be too small and was replaced by a 60 in. diameter cone in December. Experiments with spherical ferro-silicon have proved that the quantity of sink material can be further reduced and the new grease belt recovery section has been designed accordingly. Construction is to begin shortly.

The DE BEERS INDUSTRIAL CORPORATION announced last month that, following shareholders' approval of the increase of capital, £1,000,000 of the Corporation's share premium account has been capitalized and a special capital bonus of £1,000,000 declared. The directors have applied this sum of £1,000,000 in paying up in full at par 1,000,000 ordinary shares of £1 each, which shares are to be issued credited as fully paid to the holders of ordinary shares in the ratio of two new shares for every 15 ordinary shares held.

Southern Rhodesia.—The report of UNION AND RHODESIAN MINING AND FINANCE for 1957 shows a profit of £105,740 and £219,771 available, of which a dividend equal to 2d. per share *plus* a bonus of ½d. requires £62,500.

Nigeria.—The KADUNA SYNDICATE reports a profit of £26,419 for 1957, the accounts showing £42,607 available, of which dividends equal to 75% require £20,700. The production of tin concentrate of shipping grade in the year was 321 tons, compared with an output of 304 tons in 1956. The average grade of ground worked during the

year was 0·67 lb. per cu. yd., compared with 0·77 lb. in 1956.

KADUNA PROSPECTORS made a profit of £6,327 in 1957, £4,791 of the £9,338 available being required for dividends equal to 41⅔%. Of the production for the year of 86 tons of tin concentrate 14 tons were recovered from the recorded ore reserves, while an additional 16 tons were proved by prospecting, bringing the estimated reserves at December 31, 1957, to 101 tons.

Tanganyika.—In a recent progress report shareholders of GEITA GOLD MINING are informed that the loss of £26,256 for the quarter ended March 31 has brought the accumulated loss on operations for the past six months to £43,942. The increased operating loss is almost entirely due to unexpected metallurgical difficulties apparently associated with the high-grade mill feed drawn from recently opened sections of the mine. Shareholders have already been informed that the Geita company is unable to command further finance and it is accordingly compelled, it is stated, to use up the consumable stores on the mine, cease operations, and place the mine on a care and maintenance basis pending a decision as to its future.

Belgian Congo.—In his address to shareholders of the UNION MINIÈRE DU HAUT-KATANGA at the annual meeting last month the chairman, Mr. E. Sengier, said that the company's hydro-electric power plants now had a total capacity of 520,000 installed kW, which would ensure all needed power for many years. In addition to certain extensions and modernizations to existing plants, the company is now building an important group of plants—called the Luilu plants—in the western region of its concession. The mines and concentrators of that region already account for a great part in feeding the copper and cobalt plants.

Australia.—Last month the RIO TINTO Co. announced that uranium-bearing ore is now being fed into the mill at Mary Kathleen, Queensland. Although it will be some time before uranium oxide is finally produced, the power station has been working for several months and recently the sulphuric acid plant was put into operation. The start-up of the mill is many months ahead of schedule, only 27 months having elapsed between preparatory site clearing and the completion of a fine modern township of 221 houses with all amenities, a large dam, and the mill and associated plant. In addition, considerable development of the mine itself has been carried out with large quantities of ore stockpiled.

The accounts of the CONSOLIDATED ZINC CORPORATION for 1957 show a profit of £1,769,986 and £2,909,408 for appropriation. Dividends equal to 3s. 9d. on the ordinary shares require £1,137,435. In the year the ZINC CORPORATION mined a total of 762,912 tons of ore for a production of 90,820 tons of lead, 2,198,457 oz. of silver, and 139,684 tons of zinc concentrates, as compared with 80,625 tons of lead, 2,000,317 oz. of silver, and 133,661 tons of zinc concentrates in 1956. NEW BROKEN HILL CONSOLIDATED mined 722,722 tons of ore for a production of 64,794 tons of lead, 1,704,892 oz. of silver, and 154,325 tons of zinc concentrates, as compared with 47,950 tons of lead, 1,206,308 oz. of silver, and 137,990 tons of zinc concentrates in the previous year. Ore reserves of both mines have been fully maintained by development work throughout the year.

In an interim report to shareholders of the LAKE GEORGE MINING CORPORATION issued last month it is stated that, in order to meet the threat to operations caused by slumps in world prices for lead, zinc, and copper in the last half of 1957, a determined effort was made, in co-operation with the labour force, to increase the output of the mine from 16,000 tons to 18,000 tons per four-weekly period, a target achieved in the first operating period of 1958 and successfully held since. Production of pyrites concentrates was resumed in July, 1957, and output has been fully sold since that date. In addition to supplying the traditional buyers at Port Kembla a further contract was secured for the supply during 1958 of 10,000 tons to 15,000 tons to the SULPHIDE CORPORATION at Cockle Creek and regular weekly deliveries are being made. The increase in production, allied with substantial reductions in costs and the additional revenue from pyrites, has, it is stated, halted the heavy losses that were being incurred in the earlier part of the financial year.

Last month the BROKEN HILL PROPRIETARY COMPANY stated that the directors of WELLINGTON ALLUVIALS had announced that " in view of recent disappointing results and unlikelihood of profitable operations in future they consider shareholders' interests will be best served by cessation of dredging at the end of May."

The directors of NORTH KALGURLI (1912) and GOLD MINES OF KALGOORLIE (AUST.)

recently announced that the interest in KALGURLI ORE TREATMENT previously held by North Kalgurli (1912) had been acquired by Gold Mines of Kalgoorlie.

Malaya.—A profit of £89,107 for 1957 is reported by AMPAT TIN DREDGING, dividends equal to 27½% requiring £39,531. The company produced 1,150 tons of tin concentrates in the year.

Earlier this month shareholders of TEKKA-TAIPING were informed that the resolution to wind up the company by a members' voluntary liquidation was duly passed at the extraordinary general meeting held on June 2 and a liquidator has been appointed. It is anticipated that an initial distribution of 7s. per share will be made shortly.

Thailand.—The SIAMESE TIN SYNDICATE reports a profit of £277,941 for 1957, the accounts showing £307,350 available, of which dividends equal to 1s. 1½d. a unit require £70,691. In the year production amounted to 3,281 tons of tin concentrates.

Burma.—In a recent interim report shareholders of the TAVOY TIN DREDGING CORPORATION were informed that from April to December both dredges maintained more or less continuous operations though hampered by many difficulties. In view of the limited payable ore reserves now disclosed at Theindaw and their marginal nature at current tin metal prices neither the ordering of a new bucket band nor the modification of the dredge (at a cost of approximately £79,000) could be recommended by the general managers, it is stated. The only course left open apart from closing down the dredge immediately is to continue dredging operations on a month-to-month basis by effecting temporary repairs as long as operating profits accrue and it has been decided to do this.

Spain.—The report of the THARSIS SULPHUR AND COPPER COMPANY for 1957 shows a profit of £220,234 and £440,031 available for appropriation. A dividend equal to 12½% requires £89,844, while £150,000 has been placed to reserve, leaving £200,187 to be carried forward. Shipments of pyrite in the year under review totalled 692,837 tons.

DIVIDENDS DECLARED

* Interim. † Final.
(Less Tax unless otherwise declared.)

†**African Land and Investment Co.**—8d. *plus* 1s. 5½d., payable July 15.
†**Ampat Tin Dredging.**—17½%, payable June 28.
Anglo American Corporation of South Africa.—Pref. 3%, payable Aug. 7.
Anglo American Investment Trust.—Pref. 3%, Ord. 7s. 6d., payable Aug. 7.
***Cam and Motor Gold Mining.**—6d., payable Aug. 8.
†**Cape Asbestos.**—12½%.
***Central Norseman Gold Corporation.**—1s. 9d. Aust., payable June 27.
***Consolidated African Selection Trust.**—9d., payable June 27.
***Consolidated Co., Bultfontein.**—7d., payable July 28.
***Consolidated Gold Fields of South Africa.**—1s., payable July 25.
***Eastern Rand Extensions.**—9d., payable Sept. 4.
***Griqualand West Diamond Mining.**—2s. 10d., payable July 28.
†**H.E. Proprietary.**—10%, payable June 26.
†**Henderson's Transvaal Estates.**—15%, payable July 19.
†**Kaduna Prospectors.**—8d., payable July 8.
†**Kaduna Syndicate.**—7d., payable July 8.
†**Kramat Tin Dredging.**—15%, payable July 2.
†**Kuala Kampar Tin Fields.**—40%, payable June 11.
***Loloma (Fiji) Gold Mines.**—3d. *plus* 9d. Aust., payable July 4.
***Lower Perak Tin Dredging.**—1s., payable June 25.
†**Minerals Separation.**—1s., payable June 26.
***Mufulira Copper Mines.**—8d., payable July 2.
***New Jagersfontein Mining.**—6d., payable July 28.
†**New Pioneer Central Rand.**—2s. 6d., payable Sept. 4.
Powell Duffryn.—Pref. 2⅜%, payable July 1.
***Rand Selection Corporation.**—1s., payable July 18.
***Rhodesian Selection Trust.**—1d., payable July 2.
***Roan Antelope Copper Mines.**—1d., payable July 5.
†**Selection Trust.**—52½%, payable July 31.
†**Siamese Tin Syndicate.**—5%, payable July 3.
***Turner and Newall.**—5%, payable July 19.
***Union and Rhodesian Mining and Finance.**—2d. and ½d. bonus.
***West Rand Investment Trust.**—1s. 3d., payable Aug. 7.
***West Witwatersrand Areas.**—1s. 7½d., payable Aug. 8.
†**Zambesia Exploring Co.**—14%, payable July 22.

METAL PRICES

June 11.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	180	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98%–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	25	0	0
Silver		6	3½
Gold	12	9	5½
Wolfram (U.K.)		—	
(World)	3	17	6

Tin, Copper, Lead, Zinc — See Table, p. 368

Handling Iron Ore in Bulk

Hugh G. Jarman

Mechanical systems dealing with 100 tons of ore a minute are described.

The huge United States steel mills along the Great Lakes must accumulate adequate reserve stocks of iron ore, limestone, and coal to keep them going during five months' period of the winter freeze-up when all shipping on the Lakes comes to a complete halt. This, together with the rapid expansion of the steel industry which has resulted in a vastly increased consumption of raw materials for the furnaces, has forced the steel companies to go into the mechanical handling of raw materials to a greater extent than ever before. Most modern steel mills in fact mechanically-handle their entire requirements of raw materials.

This raw material storage and handling phase of the steel-making industry has been complicated by the necessity of providing larger storage space for the increased number of blast-furnaces; domestic and foreign ores, fine ores for sintering, taconite pellets, sinter, and limestone must all be available as required. Indeed, the complete integrated steel mill may cover an area of over 1,300 acres and have an annual rated steel ingot capacity of 5,520,000 tons.

The plant described here consists of seven blast-furnaces, 34 open-hearth furnaces, seven batteries of coke ovens, and a variety of finishing mills. Normal plant operations there require nearly 5,500,000 tons of iron ore annually, 3,500,000 tons of coal, and 1,500,000 tons of limestone.

Until three years ago the storage of approximately 3,000,000 tons of iron ore and limestone was handled in a storage yard between a ship canal and the furnace high lines. The company engineers in their plans for the future recognized the long-range implications of the gradual change in raw-materials technology and decided to create a new iron-ore storage facility. It was planned to hold 2,500,000 tons of iron ore and the same amount of limestone as its initial capacity. However, the need to store increased tonnages of a wide variety of materials required considerably more ground. The nearest available storage site was more than a mile away and the desired unloading rate was to exceed 6,000 tons per hour, a rate which would have imposed an impossible burden on the company's own railway system. After a complete study had been made mechanical-handling engineers were called in to design a system of high-capacity belt-conveyors which could receive materials

Stockyard for More than 10,000,000 Tons of Basic Materials.

60-in. Conveyor Installation.

from the ships' unloaders or self-unloading vessels at the canal and transport the material to the new storage area or direct to the screen house, as desired.

The same system can also reclaim the raw materials from storage when operating in reverse and return them on the same belt-conveyors to the screen house and trestles serving the blast-furnaces. The system consists of more than 1½ miles of belt-conveyors 60 in. wide operating at speeds up to about 500 ft. per minute, it having been concluded, after all other forms of transportation were considered, that belt-conveyors would best conform to the several requirements and give less interference with existing structures, tracks, access roads, and service facilities. They would also permit all-weather operation on stockpiling and reclaiming and a handling rate of 6,000 tons of iron ore per minute into storage.

This peak handling rate of 100 tons per minute represented a serious problem, because, at the same time that the project was undertaken, that capacity was believed to be substantially greater than that of any belt system in existence. The conveyor layout involved complications in the design of transfers, turns, and reversing drives, while the design had to take care that it anticipated the known and unknown variable materials which were to be handled over the system in future years.

In the event the soundness of the decision to use belt-conveyors has been demonstrated completely by the efficient manner in which the system has worked during the first three years of its operation. When a lake boat or ocean vessel of up to 20,000 tons capacity comes into the canal for unloading it ties up at the south end of a 4,000-ft. dock where four huge boat unloaders are positioned to handle the cargo. The buckets of these massive machines dip down into the holds and pick up 17 tons of ore at one bite. The four unloaders working together can unload 20,000-ton cargoes in about seven hours. Feeders and conveyors built into the structure of these monsters permit them to stack out to an adjacent storage area, or they may discharge into heavy-duty travelling apron fenders which are attached to and propelled by the unloaders. Each of these has a capacity of 1,500 tons per hour and they feed ore at a uniform rate to the belt-conveyor system.

This belt system consists of six principal units :—

Conveyor No. 1.—60 in. wide and 1,200 ft. between centres ; horizontal and inclined ; running along the dock ; receiving ore from four boat unloaders or from the self-unloading boats.

Conveyor No. 2.—60 in. wide by 1,712 ft. long centres ; generally horizontal in a high overhead gallery leading to the new storage field. This belt is reversible so that the conveyor can also be used to reclaim from the storage.

Conveyor No. 3.—60 in. wide by 2,085 ft. long centres ; horizontal and reversible ; equipped with travelling stacker for dis-

tributing materials into storage with a travelling hopper for receiving on reclaim.

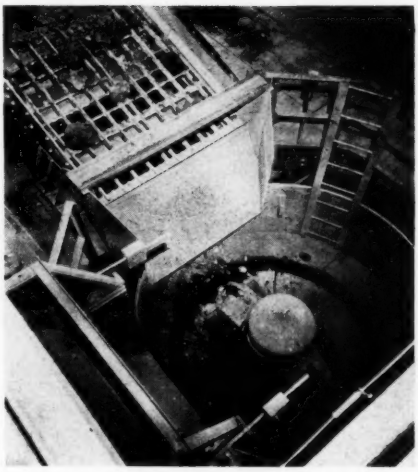
Conveyor No. 4.—48 in. wide by 156 ft. long centres; inclined and used only for reclaiming. It receives from Conveyor No. 3 and delivers to Conveyor No. 2, both of which are operating in reverse on reclaim.

Conveyor No. 5.—60 in. wide by 361 ft. long centres; inclined; running between the junction point of No. 1 and No. 2 and the top of the trestle high-line bins. This belt is used for the direct movement of materials between boats and furnaces, or in reclaim between new storage facilities and high-line trestle.

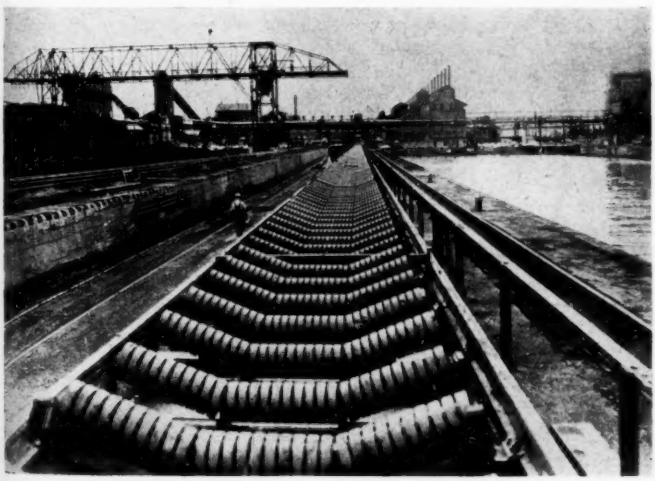
Conveyor No. 6.—60 in. wide by 44 ft. centres; reversible shuttle conveyor with double wing belts which distribute into eight separate high-line bins.

The four travelling apron fenders, operating over the 800-ft. horizontal length of the dock conveyor belt No. 1, work individually or in unison as required. These feeders can pass occasional lumps of ore as large as 36 in. by 14 in. by 14 in. The design has been worked out to avoid the use of continuous skirt boards. Instead 200 rubber-cushioned impact troughing idlers on 2-ft. centres with 30 separate rolls on each idler shaft have been fitted for a distance of 800 ft. along the conveyor. These impact idlers cushion the belt from the shock caused by the discharge of lumps from the feeders.

At the main right-angle transfers between conveyors 1–2 and 5 and also between 2–3 there was considerable concern regarding the possibility that the large columns of sluggish ore might plug ordinary chutes and create a major spillage problem. The practical solution was to use short-centre speed-up belts instead of transfer chutes. These units with relatively small pulleys and rubber impact idlers make up a belt especially designed to resist impact and abrasion and assure dependable transfer of ore that might otherwise build up in the valley angles of ordinary sloping chutes. These belts also move at approximately the same speed as the



Crusher for Oversize Ore.



Rubberized Idler Pulleys to Absorb Shock.

Stacking Coal.

main belts and thus feed the ore at a uniform rate and with a minimum drop. By using this arrangement the potential impact and abrasion damage to the long expensive conveyor-belts is minimized.

All the main belt galleries of the system are equipped with walk ways on both sides of the 60 in. wide belts for ready access. For the stockpile and reclaim operation a 300-ft. span double-cantilever main trolley bridge recasts the ore or limestone into high piles after the discharge from Conveyor No. 3; a reclaim rate of 1,200 tons per hour can be handled by the system.

The travel speed of the belts is determined after consideration of width, tension, internal construction, cover thickness, design of transfers, and belt cleaning devices. When all these factors were evaluated a speed of 500 ft. per min. was found to be the most satisfactory. All the conveyors have dual drives. The primary drives are usually rated for 500 h.p. or 600 h.p. and secondary drives are 200 h.p. Conveyors which operate in both directions have a third single drive of 200 h.p. located on the opposite side of the floating take-up. This arrangement prevents the maximum belt tension from being transmitted through the take-up when the conveyor is reversed. Direct-connected double-reduction parallel shaft gear drives are used on all main conveyors. The use of tandem drives allows considerable interchangeability of spares for all drives and limits the largest size reducer. The largest dual drive is one of 850 h.p. on Conveyor No. 5, which is inclined 16½° throughout its entire length.

A means of feeding ore or limestone properly into the existing flow system was also designed. This system handles material at 800 tons per hour. Eight high-line bins, constructed at the south end of the trestle opposite the junction of conveyors Nos. 2-5 and 1, provide a live storage supplement of several existing bins of about 800 tons capacity. These bins hold the major types of ores and pellets used at the mill.

Material is delivered to ore-bins at the head of No. 6 Conveyor by the shuttle conveyors with their wing belts. These being reversible, materials can be conveyed to their proper bins. One line of four bins above the trestle normally receives the lump ores for transfer to each blast-furnace as it requires to be fed.

The sinter plant is served by an adjacent line of four bins. These sinter ore-bins are arranged in pairs over two collecting-blending conveyors. Each of the bins discharge in turn on to a scalping screen. Oversize material is discharged into a gyratory crusher, while smaller material passes through the storage bins. The arrangement of the right- and left-hand bin feeding system, the variable capacities of each, and the single crusher permit considerable flexibility in blending.

The entire system described, taken as a whole, operates around the clock automatically with the minimum amount of manual labour at a greater capacity, it is claimed, than ever before carried on any other belt-conveyor system.

A Gypsum-Anhydrite Deposit in Somaliland

A. J. Warden and J. W. Pallister

Abstracted from a report by the Geological Survey Department.

Introduction

A report on the Suria Malableh gypsum-anhydrite deposit recently submitted to Government gives an account by Mr. Warden on the geology of the area and then an assessment of reserves by Mr. Pallister, Director of the Geological Survey. The accompanying article summarizes these accounts of a deposit situated nine and a half miles from Berbera and long recognized as an important source of mineral conveniently near a port. The occurrence, situated on a hill, lies at the entrance to a broad valley occupied by the Talabo Hun or Suq Daireh " tug," traversing the coastal range of hills. It is located on a camel track/stock route which follows the " tug " across the coastal plain. The area is readily accessible and has a " guban " type climate, the temperatures during the winter season being equable, in the region of 80° to 90° F. After the " Gu " rains in the spring, however, the " Kharif " sets in and this dry scorching monsoon wind renders the coastal area inhospitable during the summer months. The humidity is relatively high.

The people who inhabit this part of Somaliland belong to the Habr Awal, Esa Musa, and Mohamed Esa tribes, there being no static population. Test pits which hold permanent gypseous water constitute a convenient watering point for nomads *en route* to Berbera.

Geomorphology

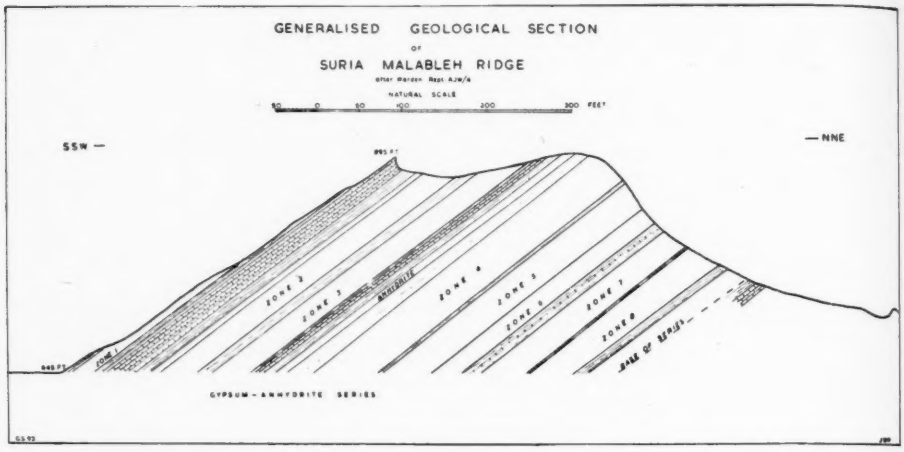
The gypsum-anhydrite deposit forms a low cuesta ridge flanking the higher Dubriat Hills lying immediately to the east, which are comprised of Lower Eocene Auradu Limestone. The intervening Allahkajid limestones and shales have been preferentially eroded to form a valley between the two ridges. The outer ridge of gypsum and anhydrite is breached by a series of short lateral " tugs " draining the dip slope of the Dubrait Hills which cut it into a series of segments. These lateral " tugs " join up with the Talabo Hun immediately to the west of the latter ridge.

The area to the immediate south-west of the gypsum takes the form of a flat sandy scrub-covered plain occupying a gap in the coastal range. This plain is cut by the numerous broad sandy-bouldery distributaries of the Kala Jab " tug " where it splays out to form a broad delta at its junction with the Talabo Hun. Isolated whale-back ridges form a prominent feature on the plain. The valley has been formed from a zone of intensive strike faulting. Further to the west the horizontal Nubian Sandstone strata giving rise to typically " embattled type " topography forms the westerly continuation of the coastal range.

The gypsum ridge is largely swathed in patches of rubbly scree, especially on the dip slope. The scree frequently occurs in large piles near the foot of the slope, loosely cemented by earthy material. There is a slight tendency towards the development of a karst-type topography. This is best seen in the main limestone band where a few pot-holes are developed penetrating through the limestone and underlying marls into the gypsum below. The development of a cave in the marls at the southern extremity of the limestone outcrop is due to the preferential erosion of the underlying marls due to strongly developed eddies which occur when the " tug " is running. Drainage gullies on the dip slope of the gypsum-anhydrite massif have become deeply incised where the protective covering of limestone has been stripped off. These drainage systems take the form of two inverted interlocking triangles at the apices of which a single channel formed by the linking up of the drainage gullies breaches the limestone at " tug " level.

Geology

The succession exposed in the hill is some 395½ ft. in thickness, and comprises the basal part of the Gypsum–Anhydrite Series. This



lower part of the series together with the underlying Allahkajid Beds and Auradu Limestone form the Lower Eocene succession. Rocks examined below the gypsum-anhydrite succession comprise the upper beds of the Allahkajid Series.

Upper Allahkajid Beds.—The upper El Allahkajid Beds exposed at the base of the gypsum-anhydrite succession are a transitional series between the massive Auradu Limestone forming the hills to the east and the overlying Gypsum-Anhydrite Series. During the deposition of this transitional phase conditions became gradually adjusted to those prevailing during the formation of the Gypsum-Anhydrite Series. This is evinced by an increasing gypsum content in the rocks. In the interbedded buff marly shales and pinkish limestone bands gypsum occurs in a variety of forms. It features as scattered flakes, well-developed crystals of selenite, platy crystals forming veins, and as nodules composed of stellate radiating aggregates of elongate tabular crystals in a marly matrix. It is improbable that these minerals were formed from solutions percolating through from the overlying beds of gypsum, screened as they were by beds of impermeable marly shale. The impermeability of such beds is well illustrated in the test pits in the lateral "tug" in which water is impounded by one of these underlying shale bands. The gypsum would therefore appear to be of authigenic origin and was probably crystallized out locally from the high gypsum content disseminated through the shales. Gypsum of similar occurrence—*i.e.*, scattered flakes of selenite and bands of satin-spar occurs in the limey shale bands, interbedded between the thin limestones in the Jurassic at the base of the escarpment in the Makhir Coast area. In this case the gypsum is definitely formed *in situ*, since beds of gypsum which could give rise to migrating solutions are often entirely absent.

Gypsum and Anhydrite.—Most of the main gypsum-anhydrite series is composed of recrystallized gypsum after anhydrite. In all the specimens of gypsum sectioned relict wisps of anhydrite were observed in the gypsum. The formation of gypsum at the expense of anhydrite may, however, prove to be merely a superficial weathering phenomenon.

The anhydrite band which outcrops at the junction of the small lateral gully with the main Suq Daireh Tug tends to be more resistant to weathering than the surrounding gypsum. It forms a distinctive ridge running up along a shoulder of the hill. In some places where progressive hydration has taken place along the joints in the anhydrite flags every degree of alteration can be seen from the development of gypsum along the joints and cracks to form a "crazy pavement" of anhydrite flags with "interstitial gypsum cement" to relict nodules and knobbly projections of anhydrite in a rock mainly composed of gypsum.

The anhydrite is a dense crystalline greenish-grey rock a little heavier than gypsum with, in some cases, a slightly developed brown banding. Unlike gypsum it cannot be scratched with the finger nail and it emits a ringing sound when struck

with a hammer as compared with gypsum which gives a dull " boss " sound when so struck. Small glistening elongate prisms of anhydrite can be distinguished in the body of the rock. White flaky patches on fractured surfaces are another characteristic feature of this type of rock.

The gypsum is found in massive beds, in fine bands alternating with marls, in a " pseudo-breccia," or as concretions in limestone. In some instances, notably near the top of the succession, banding was seen to be intricately contorted by hydration. Only certain horizons are affected, while the adjacent bedding remains undisturbed. The contortion banding is " depicted " by the presence of white marly lamellae and bands of fibrous satin-spar associated with the normal crystalline gypsum. The bands are often extremely puckered and show the development of secondary plications on the main first-order folds. Overfolds and " pinch and swell " structures are often seen in the satin-spar bands. In some instances small-scale thrust-faulting was observed. These hydration structures in the gypsum are to be expected where a 40% increase in volume takes place on hydration under confining stresses. It is peculiar, however, that some of the gypsum specimens which clearly show relict anhydrite in thin section, and therefore appear to be after anhydrite, show normal undisturbed bedding.

The extensive rubbly brecciation seen on the exposed bedding planes is probably due to " hydration ruction " (comparable to frost heave in the periglacial zone). On expansion the gypsum resulting from the alteration of anhydrite probably produces a " rucking up " effect to form patches of scree. Such areas of scree are common where the gypsum is exposed immediately above the main limestone band. There has been a tendency for the scree to creep downslope with subsequent recementation by loose earthy material.

The gypsum immediately overlying the main limestone shows what might best be termed a pseudo-brecciation effect. The gypsum is divided up into irregular lenses which are separated by a plexus of recrystallized lamellae of fibrous satin-spar and irregular tiny bands.

Gypsum in its typical form occurs most commonly as a greenish-grey crystalline rock slightly lighter in colour and less dense than anhydrite. It can be scratched with a finger nail. It frequently contains marly bands of varying thickness, occasionally small flinty nodules, and in some instances yellow nodular concretions which are probably dolomitic in nature. In another common variety gypsum takes the form of brown platy crystals with earthy partings.

The common association of gypsum with limey bands through the succession seems to indicate either: (1) Repeated variation in the conditions of deposition giving rise to the formation of calcareous bands often only 1 mm. in thickness, followed by a reversion to prevailing conditions of anhydrite-gypsum deposition, or, (2) deposition of limey bands simultaneously with anhydrite and gypsum due to repeated variation in the lime content of the area. It is probable that the latter condition prevailed in this case as there is a considerable overlap in the precipitational range of the carbonate and sulphate during evaporation.

Gypsum nodules occur in the main concretionary limestone band. Here pure-white finely-crystalline nodules of gypsum, accompanied by a series of fine radiating cracks infilled with gypsum in the surrounding limestone, occur scattered through the rock. The cracks in the limestone appear to have resulted from the force of crystallization exerted during the formation of the gypsum. It is probable that some of the gypsum at least is after anhydrite as a few relict crystals of the latter were observed in thin section.

Although irregular partings do occur along which migrating solutions might have gained access—and some of the fissures present are infilled by gypsum deposited from such solutions—it seems improbable that most of the nodules can be accounted for in this manner. Many of the nodules have no partings or planes of access through which solutions could have moved. The gypsum nodules were therefore probably formed by the expression of the gypseous fraction from the limestone and local concentration *in situ*. The presence of original anhydrite points to this method of formation.

Limestone.—Limestone and marls of varying thickness feature throughout the succession, typically as frequent thin calcareous partings. Thicker limestone bands are are also common, the most prominent of which is the main limestone forming much of the dip slope of the Prospect. This bed forms a good marker horizon. It is a white concretionary marly type of rock with numerous nodules of gypsum and brown-weathering, white, compact, irregularly-

lensing patches of arenaceous limestone which show up prominently on the exposed bedding-plane.

The limestone is seen to thin towards the north-west and a greater thickness is exposed in the outcrop flanking the " tug " to the south-east of the area surveyed. A thin section of a specimen W 318 taken from the arenaceous limestone reveals numerous fresh granular crystals of quartz in a calcareous matrix. This type of calcarenite represents sandy patches in the original sediments.

None of the thicker limestone bands within the main gypsum succession yielded any fossil remains. Small gastropods were however recorded from a thin marly band approximately ¼-in. thick which occurs immediately above the basal shaly marls.

Marly Shales.—Buff-coloured marly shales occur principally at the base of the main limestone, associated with limestone and gypsum bands above the anhydrite bed, and also with the limestone bands outcropping in the first gulley off the lateral " tug." These shales also occur 22 ft. above the base of the gypsum-anhydrite succession and are found in association with the underlying Allahkajid Beds. Gypsum is common in the shales as satin-spar bands mainly aligned roughly parallel to the bedding or as lustrous transparent isolated crystals, the latter being also common in the shales underlying the gypsum-anhydrite massif. There is a slight tendency towards rhythmic deposition in that the limestones are often preceded by a marly-shaly phase.

Faulting and Tectonics

No faulting was recorded in the actual area mapped although the plain to the immediate south-west is affected by a fault complex of Red Sea trend, bringing up wedges of Jurassic and Cretaceous on the opposite side of the valley and ridges of basement further to the south.

The rocks of the area strike north-west to south-east. They are fault-tilted rather than folded, the strike of the succession conforming to the predominant fault trend. The dips throughout the succession are fairly constant averaging from 35–45° S.W.

Economic Considerations

Much of the purer gypsum in the area mapped appears to be of workable quality. The most favourable horizon some 97 ft. in thickness excluding intercalated marls and limestones but including the anhydrite band is located about 40 ft. stratigraphically below the marls underlying the main limestone. There is a decrease in calcareous content downwards and at this point the gypsum is relatively pure.

A second lower horizon probably worth working is approximately 50 ft. in thickness and is situated below the thin limestone bands which outcrop in the first gulley leading off the lateral " tug." The upper workable beds could possibly be quarried where the two lateral " tugs " draining the dip slope of the succession have cut through the overlying main limestone and become deeply incised. The gypsum here is readily accessible where these drainage channels unite and break through the limestone at two places, at the bottom apices of the letter W formed by the edge of the main limestone outcrop at the level of the Suq Daireh " tug." A considerable quantity of poorer gypsum forming the overburden would however have to be stripped off before the better-quality rock 40 ft. below the main limestone could be worked.

Estimate of Reserves

The vast gypsum-anhydrite resources of British Somaliland have been briefly described by Hunt (1954).[1] The proximity of the Suria Malableh deposit to the port of Berbera was stressed and investigations on the locality have been undertaken by the Geological Survey during the last three years. Inquiries by a number of commercial firms have been made from 1953 onwards and an Exclusive Prospecting Licence was taken out by Messrs. Ommaney and Ganguli in 1954 over eight square miles. They carried out no work on their concession however and the licence was surrendered in 1956. Samples were taken by the Geological Survey in March, 1955, on behalf of the concessionaires and additional work was carried out in 1955–56. A more comprehensive programme of mapping and sampling was undertaken early in 1957 by Warden (1957), when a stretch of about 1,800 ft. long of the main ridge was mapped by plane-table and contoured at 50-ft. intervals; some 623 channel samples were taken of the Gypsum-Anhydrite Series as exposed with the exception of about 30 ft. at the basal transition to Allahkajid Beds. The samples were

[1] A list of references is given at the end of the article.

sent to the Mineral Resources Division, Directorate of Overseas Geological Surveys, which undertook a full mineralogical examination followed by 242 chemical analyses.

The samples were all taken at outcrop and no analyses of sub-surface samples are yet available. It is, therefore, a matter of importance as to how far the samples may be taken as representative of the succession beneath surface. Two variants are possible ; the proportion of gypsum to anhydrite and the proportion of total sulphates to carbonates. Warden's mapping shows comparatively little apparent variation along the strike and it seems probable that no more marked changes occur down the dip ; limestones may vary from one to three feet in thickness and possibly there may be some corresponding slight variation in carbonate content of sulphate beds. In such beds up to 60 ft. thick the variation of carbonate content may be expected to be mainly limited to the upper or lower two or three feet and therefore have little appreciable effect on the total average grade.

The possibility of surface gypsum passing into anhydrite beneath a zone of weathering has to be considered. Analyses show, however, that anhydrite is common in the upper few feet of the succession which form a dip-surface. As this anhydrite has survived little surface hydration seems to have occurred. The surface samples are therefore taken to be fairly representative.

The mass considered in the assessment of reserves is that part of the ridge formed by the Gypsum-Anhydrite Series extending along the strike of 1,800 ft. mapped by Warden and limited at base by the level of the adjoining dry river bed. The bands of sulphate are well differentiated in broad zones from the carbonate beds. Apart from a comparatively thin bed near the top, 11½ ft. thick with a two and a half foot zone of anhydrite, gypsum is of a consistently high grade over thicknesses ranging from 23 ft. to 63 ft. Such zones have been selected with limits usually when the grade falls below 85%. Only such broad zones economical to quarry have been included in reserves, but they form nearly two-thirds of the total thickness of the series.

Conclusions

Part of the Suria Malableh Ridge made up of the Gypsum-Anhydrite Series has probable reserves of 6,500,000 tons of massive and bedded gypsum with a grade of over 90% and only 3% carbonates. A bed of anhydrite, 7½ ft. thick, comprises nearly 400,000 tons of over 95% purity.

The area mapped and sampled comprises only about one-fifth of the three segments of the ridge and there are therefore possible reserves of the order of 30,000,000 tons of high-grade sulphates in this area.

The ridge, which is shown in the accompanying section, is approximately 350 ft. high above the level of the adjoining dry river bed and it is cut by two narrow transverse valleys giving easy access to nearly the whole sequence. Gypsum and anhydrite beds can therefore be readily worked by open-cast methods.

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WARDEN, A. J., 1957. "Geological Report on the Suria Malableh Gypsum Anhydrite Deposit, Berbera District. (*Summarized here.*)

Engineering at University College

In March, 1956, attention was drawn to an appeal being made to industry for funds to finance the construction of a new engineering building for University College, London. The subscription of £371,000 by business concerns and a grant of £380,000 from the University Grants Committee has at last permitted a start to be made on the project, work having commenced earlier this month. In the original appeal it was pointed out that owing to inadequate accommodation and facilities the College could accept only one of every nine applicants and of these at least seven were suitable for entry into the Engineering Departments. The £371,000 already subscribed by industry is, it is suggested, tangible proof of its recognition of the seriousness of the problem. On completion of the new building, which is to be on a site in Torrington Place adjacent to the College, U.C.L.'s output of trained engineers will be increased by some 50% to over 100 a year. As further funds become available two large additional wings will be added and the College will then be able to accommodate about 600 engineering students, corresponding to an annual intake of approximately 200, including candidates for higher degrees.

Westralian Notes

G. Spencer-Compton

The author draws attention to recent events affecting the mining industry.

Sons of Gwalia

The Sons of Gwalia mine, at Leonora, is to receive aid from the Western Australia State Government to the extent of £100,000 (free of interest) for the purpose of " putting into operation a modern crushing plant." This information will be received with considerable pleasure and relief by many, for it shows the favourable attitude of the Government to the mining industry.

By this action the operations of a famous mine may be restored to a reasonable level of security. In recent years the prospects have not always been rosy and operations have been beset with all kinds of difficulties. No dividends have been paid since 1950—a matter of some concern, as well as a " reversal of form " in a mine which has made returns to shareholders so consistently for such a long period. However, the future is viewed with a considerable amount of optimism and there are definite indications that things are, even now, shaping up better than has been so far reported. The £100,000 grant is a real tonic and it is sincerely to be hoped that the Sons of Gwalia company, its mine, and its people, as well as the dependent people of Gwalia and Leonora, will emerge successfully from the uncertainty which now encompasses them.

In March, 1896, Edward (called " Doodah ") Sullivan found gold at a place a little north of the place where Leonora now stands; it was founded in 1899. Other finds of value to July, 1896, followed and some ore from the place was carried by camels to Menzies for treatment; the first 8 tons yielded 1,000 oz. On July 2 that year Sullivan died; his grave is still preserved on his old lease, with white quartz stones and a marble tablet and inscription.

In June, 1896, a good find was made several miles to the south by Carlson, Glendenning, and Smith. These men were prospecting in the bush on behalf of Tobias Brothers (goldfields storekeepers with headquarters in Coolgardie). Nearly all the men associated with the discovery were Welshmen and the new lease was registered as No. 190 C " The Sons of Gwalia." It was soon seen that something " of more than ordinary interest " had been brought to notice. In August G. W. Hall, of the London Finance and Mining Agency, secured the option for £5,000 and soon recognized that a large quantity of payable ore was already exposed. He then set to work to add other leases and finally he had seven, each of 24 acres, in a compact block—a total of 168 acres. Several mining engineers of Coolgardie, including Edward Hooper, Ernest

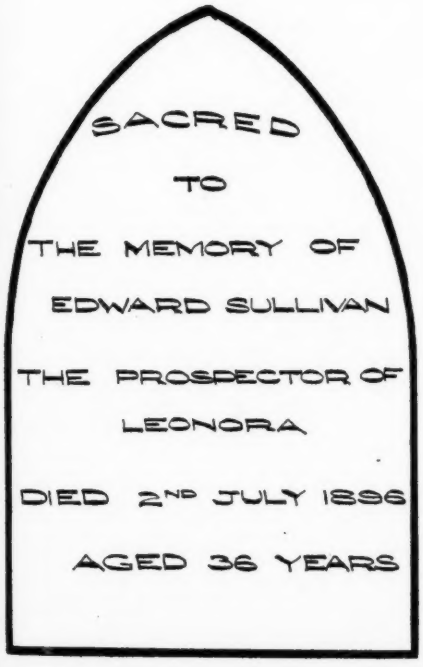
Sullivan Memorial, Leonora.

Williams, and (later) Herbert C. Hoover and Hasard inspected the new area and were very greatly impressed and by December, 1897, Bewick, Moreing, and Co. were in control.

The first crushings in 1897—200 tons for 1,200 oz. (with high values still in the battery tailings) set the seal on the earlier estimates. By October, 1897, 3,800 tons had produced 5,600 oz. with 21 dwt. in the sands. During the work of development water was met at 63 ft. (potable) and Hall estimated up to "£500,000 worth of gold was in sight to water level and no trouble about our future water requirements."

The new company, of £300,000 capital, was registered in London on January 8, 1898, and from 1900 to 1905 the mine produced 380,000 oz. of gold and paid 21s. per share in dividends. The ore reserves in 1905 were given at 360,000 tons at 10 dwt. To 1957 (60 years) the mine has produced 6,000,000 tons of ore for 2,250,000 oz. of gold and paid £2,000,000 in dividends.

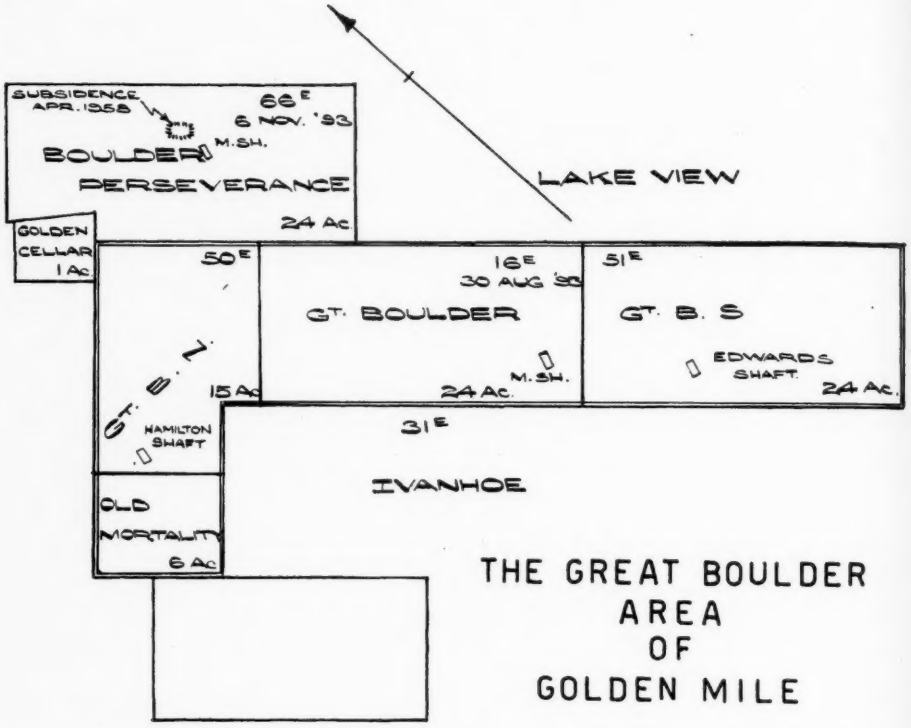
The site for the town of Leonora, almost at the base of John Forrest's Mt. Leonora, was selected by Warden Burt in 1899. In those days the prospects of the Four Mile seemed as bright as did those of the Sons of Gwalia and the new town site was placed half-way between.



Subsidence on the Golden Mile

On the morning of April 26—in the very early hours—a subsidence commenced suddenly on the Boulder–Perseverance gold mine, which in a few hours had run some 30,000 tons to 40,000 tons of old filling material into the cavities of the underground in the vicinity of the Main shaft. The rumblings and thumps that were heard or felt were somewhat alarming to those of the mine staff in residence close by and in the darkness very little of what was taking place could be observed. By daylight a huge chasm was revealed, about 100 ft. deep, 160 ft. in length, and about the same in width. This subsidence marked roughly the area of an old open cut which had been filled some years before and landscaped, but unfortunately the area affected also took in part of the east wall of the electric winder house which was seen to be in a very precarious position. There was no loss of life and no later damage to property, but the winder might have represented a major loss. Devotion to duty on the part of a few of the engineering staff and others soon had rescue operations under way and in less than 30 hours the engine was safe and drawn out of harm's way.

Organization of a high order of merit soon set to work to handle the many difficulties that now became of importance and by Monday morning, April 28, every man of the company's large pay roll was placed, although the Lake View and Star's general manager had offered to take care of any men who might have been displaced in this sudden crisis. Steps had also been taken to commence with the filling in of the great yawning hole, first with the large earth movers locally available, while preparations were made to have a very large Euclid unit sent up from Perth. The large amount of sand-filling called for meant day and night work, as well as a close watch on the chasm itself in case of a further running. By May 9 the hole was completely filled and an extra amount of filling piled over the site of the hole in case it were needed. The fill was drawn from portion of the old dump of the South Kalgurli mine, only 100 yd. or so away. In every aspect of the operations, right from the beginning, the actions of the staff and of all men employed in



the jobs were most praiseworthy and the organization by the management excellent.

The " Perse " shaft is, of course, out of operation and will be so until the problem of the winder has been solved, but many operations are " as usual," with a limited access through the old No. 6 shaft to some of the workings. Overall tonnage is expected to be maintained.

The Perseverance Lease was discovered and registered by G. Pung on November 6, 1893, when the Golden Mile was about to come into being. Not much was heard of the lease for some time, but in 1895 it was secured for a small payment and floated in London as the Great Boulder Perseverance Co., Ltd. Since those days the mine has yielded more than 6,000,000 tons of ore, for about 3,000,000 oz. of gold and 500,000 oz. of silver ; it has paid about £2,500,000 in dividends. In 1923 a reconstruction took place and the new name became the Boulder Perseverance ; a few years ago the property became part of the very extensive area under the control of the Gold Mines of Kalgoorlie (Aust.), Ltd., and it is therefore now a unit in a very large organization whose monthly production is in the vicinity of 40,000 tons.

The Perseverance lease is of 24 acres only and is remarkable for the number and extent of the workable lodes : The Lake View lode ; Perseverance ; Tetley ; Furness ; Bell ; Ophir ; El Oro ; Telegraph, and so on. Some of them were large and rich, so it is not surprising that there are some large cavities underground.

Air Search in the Sahara

It has been announced by the Aero Service Corporation, of Philadelphia, that by the end of June flying work in connexion with the search for oil in the Sahara Desert and other areas in Libya using the airborne magnetometer will be completed. For the flying operations Bengazi and Tripoli are the main centres, but an advance base has been constructed at Sebha—a small oasis in Libya.

Use of the Crusher Sampler

A note on current American practice with coal and phosphate

A. E. Williams, Ph.D., F.C.S.

While processes for the exploitation of minerals are being constantly improved, obtaining a representative sample of a bulk lot of a mineral is often a matter of chance and the method of sampling is frequently both laborious and haphazard. The harder the mineral the less the likelihood of obtaining a true sample owing to pulverizing difficulties. When pulverizing is done manually there is a great deal of hard work involved in acquiring a true sample of anything of over 3 on Moh's hardness scale, so that while analytical chemistry has kept pace with the demands made upon it in ascertaining the composition of solids which have to be processed in bulk, until recently methods of sampling often left much to be desired. A concern using 1,000 tons of coal weekly, for example, might lose a considerable sum each year if the fuel was bought on a 10% water content, as shown by sample-testing in the concern's own laboratory when the bulk supplies were carrying about 15%. A similar state of affairs might easily arise with regard to the calorific value of the fuel. If the vast number of other minerals bought in bulk are taken into consideration the necessity for accurate sampling is seen to be of prime importance.

The time-honoured method of obtaining anything like an average sample from bulk solids by coning and quartering is a time-consuming operation and often occupies a period longer than that required for testing, eight hours being a usual time if the sampler works hard and fast enough. It consists broadly of crushing, say, 1,000 lb. of the mineral down to 1-in. pieces on a hard clean surface, making it into a coned pile, then turning over and over with a shovel to form a long narrow pile. Alternate sections of the latter are then isolated, brought together, and again coned before crushing to $\frac{3}{4}$-in. pieces. This process of coning, crushing, and quartering is repeated until ultimately a powder amounting to a few pounds in weight is obtained.

The composition of this powder, if all the sampling operations have been carefully carried out, will bear a good resemblance to the bulk material. As the operation of sampling is just as important as the work to be done on the sample in the laboratory the sampler is invariably regarded as a trusted servant of the concern. It is, however, questionable whether the most devoted employee will not be tempted to discard rock or slate he finds in his sample of coal rather than go to the trouble of breaking up this

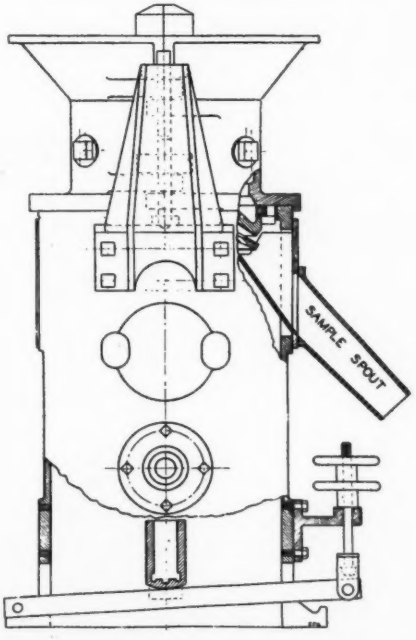


Fig. 1.

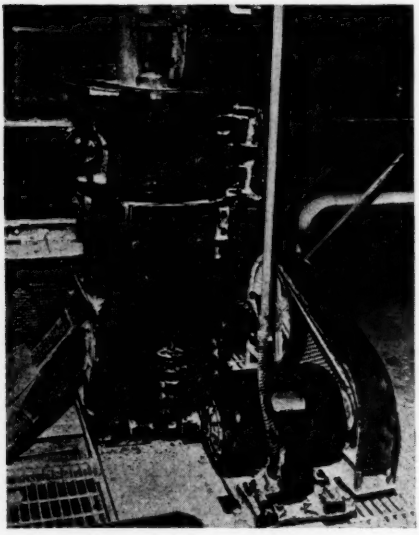


Fig. 2.

hard material in order to keep his sample representative. The temptation to reject hard pieces found in the sample is very great and each rejection impairs the sampling accuracy. It is apparent, therefore, that if the sampler's work can be taken over by a mechanical sampling device—which is not liable to human failings—the sampler would be free for work elsewhere, while at the same time accurate sampling would be ensured at a fraction of the cost.

In the United States both coal and other mineral sampling is considered an integral part of all concerns using such materials in large quantities. Over 65% of large users of coal sample all the material received to ensure that the purchase price is based on quality and not necessarily quantity. The U.S. Government in its 1955 revision of Technical Paper 133, " Coal Sampling," calls sampling one of the most important features determining successful and satisfactory application of the specification method of purchasing coal. Its purpose is in the first place to further means whereby the Government is assured of receiving the coal for which it has contracted. Secondly, to protect the interest of the Government by providing a means for determining liquidated damages if contractors fail to deliver coal of the quality guaranteed. Lastly, to provide the purchasing officer with an official basis for making his purchases on a sound, uniform footing.

American experience shows that of the 65% of coal users who check their coal some have found that they could use cheaper coal. Others have discovered that from accurate sampling penalties can be exacted and they receive them without contention from the

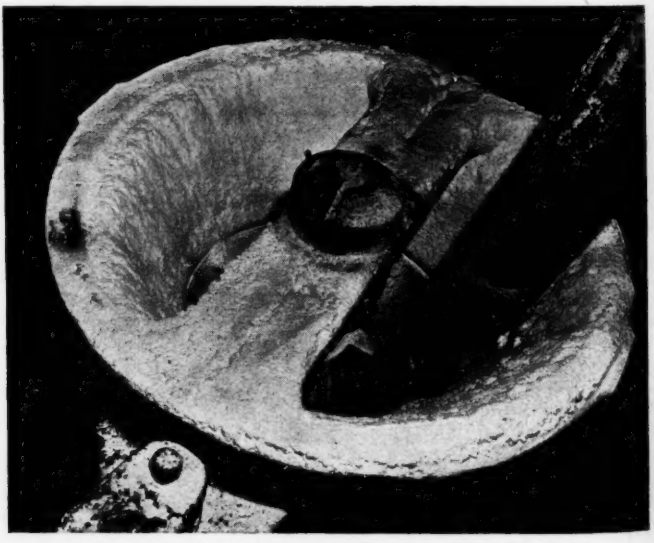


Fig. 3.

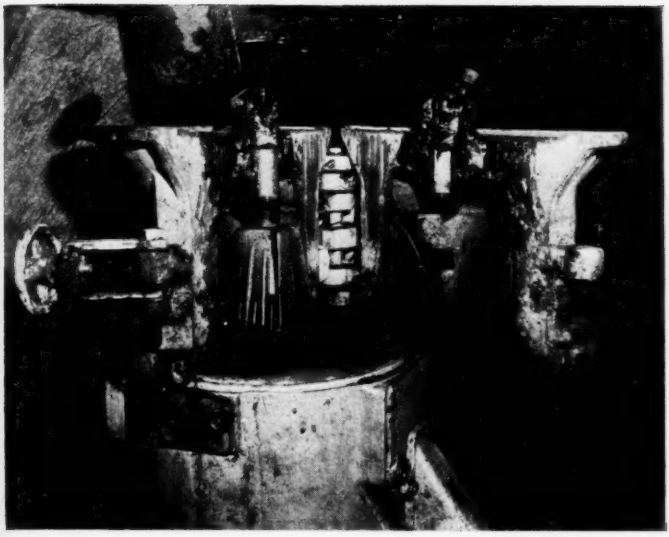


Fig. 4.

contractor. Accurate samples of every rail car or barge allow comparisons of different coals, enabling the consumer to ascertain exactly how many heat units will be developed; the user and contractor can then agree on the precise value of the fuel and costs become proportionate to value received. These firms have found that sampling and analysis is a positive check against specifications.

The U.S. Bureau of Mines is of the opinion that hand-sampling when efficiently carried out involves 34 different stages and is a complete day's work; then adds that it requires only a very short time to pass the necessary amount of material through a crusher-sampler. Modern machines of this type deal easily with minerals up to 6 Moh's hardness. Under hand-sampling methods excessive time permits moisture evaporation from the sample and the final tests in the laboratory do not show the true amount of moisture in the bulk material; so that a claim made on a laboratory test of the sample is underestimated. A unit that has become popular in the U.S.A. is the Sturtevant crusher-sampler which has been developed by the Sturtevant Mill Co., Boston. This machine (Figs. 1 and 2) was originally designed for coal and coke but is now applied to a wide range of minerals. It is capable of crushing 3-in. and smaller pieces to sizes of 6-mesh and finer, with a big proportion of 20-mesh and finer, at the rate of 1 ton per hour. Coarse grinding capacities are larger. At the same time the machine automatically chooses a truly representative sample of the material fed to it, while eliminating 32 of the 34 steps required with hand-sampling. The unit operates on approximately 3 h.p. and the horizontal or pinion shaft rotates at approximately 400 r.p.m. in a clockwise direction when viewed from the end of the shaft. Looking into the unit (Fig. 3) the vertical shaft and crushing nuts rotate clockwise at 160 r.p.m. The mineral is fed into the hopper where it is gripped by the revolving coarse crushing nut and roughly crushed against the top of the liners. It is then passed by gravity to a revolving fine-toothed crushing disc and stationary liner where the crushing operation is completed. Due to this gradual reduction process and the rotating crushing action the sample is thoroughly mixed and is ejected as a homogeneous, finely disintegrated, and fully representative mixture of the mineral passed to it, including, of course, the correct proportion of impurities.

The mineral is then discharged at the periphery of the rotating disc where 5%, 10%, or 15% of the circumferential discharge is passed through an independent sample spout; the balance passing out *via* a larger spout. The sample of mineral is not taken directly after the rough crushing operation

and then further reduced ; it is not extracted until the mineral with its impurities are finely disintegrated and thoroughly mixed. By using different sizes of spout for the passage of the sample it is possible to obtain the 5%, 10%, or 15% according to the estimated amount of impurity that is expected in the material. Where this amount is thought to be small the larger sizes of sample would be taken, but for minerals high in impurities a 5% sample would be more appropriate. The sample spouts may be changed at will and can be assembled at either side of the machine. A handwheel adjustment is fitted on the lower part of the unit to give fine or coarse grinding as required ; clockwise movement brings the grinding members together for fine crushing, while rotation in the opposite direction will open the grinding members for coarser grinding. The handwheel is normally turned slowly while the machine is running until the crushing nuts can be heard contacting the stationary grinding liners. When mineral is fed to the machine the grinding nuts will centre themselves and operate without striking the liners. While the central grinding cone and sideplates of the crusher unit are constructed to withstand long periods of heavy usage, the open-door design (Fig. 4) allows easy accessibility for quick changing of these components when required. Normal maintenance of the unit simply involves the lubrication of moving parts.

A unit of this nature is naturally interesting to power stations and a typical American station, using three of them, is the Huntley Station, Tonawanda, New York, where more than 2,000,000 tons of coal are consumed yearly. The crusher-samplers are used for 16 hours out of each 24 and the length of life of the crushing elements is between two and five years, depending on the type of fuel put through them.

Phosphates Sampling.—When detergents and water softeners are playing an ever increasing part in everyday life the production of phosphates for water treatment has become one of the major industries. As many of the finished products are marketed under trade names it is necessary to achieve quality control and the production of a standard product. To ensure this desirable result from a very mixed type of raw material it is necessary to have a reliable means of constantly sampling what enters the phosphates factory. At Westvaco Mineral Products Division, Carteret, New Jersey, the raw materials include tripolyphosphates and tetrasodium pyrophosphates, and a part of the product stream is diverted to two crusher-samplers. Of this a 10% portion is fed to sample cans for laboratory analysis. While sampling, a segregation rather than a rejection operation is taking place ; the remainder of the phosphate minerals are undergoing roasting or calcination. Based on the laboratory analysis of that portion from the crusher-sampler, the final product is stored according to pre-designated specification requirements of the firm's customers. When the 10% sample is discharged from the machine the balance of the finely-ground phosphates is passed back into the product stream. Coal and phosphate minerals are merely examples of products which can be handled with advantage in a sampler-crusher, whereby the subsequent processing of the bulk material is facilitated.

Ore-Dressing Notes

(18) *Uranium*

Production Economics

Useful information with regard to new discovery, production, and cost in the United States was given by E. A. Youngberg at a recent Uranium Symposium and reported in the February, 1958, issue of the *Mining World* of San Francisco. New ore reserves are being developed at about five times the current rate of production and 2½ times that needed to nourish the capacity now under contract. Because of this the production potential is at present adequate for all foreseeable demands. The past contracting policy of the U.S. Atomic Energy Commission kept new mill capacity in step with the developed ore reserves, but a change has now been made limiting mill expansion to about the estimated current commitment. The Government now has about 2,000,000 tons of ore stockpiled, freezing $39,000,000, and this satisfies the position. Experience has shown that the usual large shallow-bedded deposits can be brought quickly into production now the techniques have been worked out. A table (Table 1) showing typical costs was presented to the Symposium. The treatment costs for other countries were given as $2·00/ton in South Africa, $6·00/ton to $9·50 in Canada, and $10·00 to $17·00 in the U.S.A. Until 1962 the selling position is secured by Government contracts, but competition promises to be severe once the present period of establishment is ended.

Table 1

Typical Median Mining Costs Per Ton in Largest United States Mining Districts, Costs Per Pound of U_3O_8 Recovered in Same Districts, and Average Milling Costs Per Ton Based on Indicated Grade[1,2]

	Uravan Mineral Belt.	*White Canyon Monument Valley.*	*Big Indian Wash.*	*Ambrosia Lake (Grants).*	*Open-Pit Stripping Ratios* 5-1	8-1	12-1
	$	$	$	$	$	$	$
Exploration	2·00	2·00	1·00	0·50	0·30	0·50	0·70
Development	3·00	1·50	1·00	1·50	2·00	3·20	4·80
Depreciation (Plant and Equipment)	2·00	2·00	1·00	1·00	0·50	0·50	0·50
Direct mining	11·00	8·50	6·00	7·50	1·25	1·25	1·25
Indirect mining	2·00	2·00	2·00	1·50	0·75	0·75	0·75
Total	$20·00	$16·00	$11·00	$12·00	$4·80	$6·20	$8·00
Recoverable pounds U_3O_8 per ton	5·3	5·4	7·3	4·4			
Mining costs per pound of U_3O_8	3·77	2·96	1·51	2·73			
Milling cost per pound of U_3O_8	2·70	2·72	2·95	2·55			

[1] E. A. Youngberg, Assistant Manager for Operations, Grand Junction Operations Office, United States Atomic Energy Commission, Uranium Institute of America speech, December 16, 1957.
[2] A. H. Ross and Ralph Toerper, " Economics of Uranium Ore Processing," Uranium Institute of America speech, December 16.

(19) *Magnetism*

Dry Separation

Wet grinding reduces the dust hazard and aids control of the movement of particles through a dense fluid. The same kind of help is given in wet magnetic separation. When low-grade magnetic ores are treated more than 3½ tons of water are needed per ton of mineral and this sets practical limits to the use of wet methods. The Ontario Research Foundation has been studying dry magnetism for some years and several improvements have resulted for material of all sizes down to fine dust.[1] The basic developments in the work were guided by these considerations :—

(1) For dry work a single layer is ideal.
(2) Economically, high operating speeds are needed.
(3) The shape of the magnetic field can be developed to be circular, spiral, or helical.
(4) No mechanical feeding and discharge devices should be used.
(5) Gravity should aid separation.
(6) An opposing air stream must replace the water-wash used in wet magnetic concentration.

(1) above can be achieved by using small permanent magnets mounted on a rotating drum which rotates at a different speed inside an independent stainless-steel drum. The magnetic particles are thus constrained in movement. Four types of machine have been developed, from a " rougher " working on − 6 mesh + 100 mesh material down to one handling − 325 mesh dusts. The essential difference is between the appropriate dynamics for easily-settled material and that easily airborne. In a specific case the relationship between average particle size, magnet design, drum speeds, and differentials is considered in setting the machine. Two types of rougher are used. In one the feed travels on a belt at 400 ft./min. and passes over the double drum, of which the inner (magnet) drum is rotating in a reverse direction at 400 ft./min. The non-magnetics are thrown clear as the belt turns over the drum, while the magnetite clings as it is accelerated by the influence of the field flux, until it is separately discharged as the belt leaves the drum.

In the other " rougher " type the magnet drum is mounted in a second belt unit above the feed belt and travels in the opposite direction. Gaps and flux intensity are so adjusted that the magnetic particles are picked up more than once and dropped, before finally adhering to the upper belt. As they climb they are again accelerated by the differential effect. The upper belt moves at twice the speed of the feed belt and the

[1] *Trans. Canad. I.M.M.* September, 1957. " Dry Magnetic Concentration," by P. E. Cavanagh and E. W. Williams.

magnet drum rotates in the opposite direction, as before. An air blast is directed upon the climbing particles to aid separation.

Material of -60 mesh $+200$ mesh is treated in a different way. Dust is fed from a hopper on to a rotating stainless-steel drum which forms its bottom. The inner magnetic drum rotates inside this drum, but at a different speed. Its magnetic particles thus aid with the feeding by stirring the material as they feel the influence of the reversing flux. As feed leaves the hopper it is stratified with non-magnetic gangue on top. This material leaves first, magnetic middlings later, and concentrate on the rising return side of the drum. Detachment is produced by mounting the drums eccentrically, so that the gap widens sufficiently for centrifugal force to overcome magnetic attraction in the concentrate discharge zone. Air elutriation aids the separation. With this appliance magnetic flocculation may occur if the drums run too slowly, the proportion of magnetic material is high, or the population in the air stream too dense. This can be overcome by an arrangement of magnets which induces a helical field on the drum surface. Usually the magnets are mounted herring-bone fashion on the inner drum. Magnetic particles fed toward the centre of the drum now work outward and are discharged at the sides, while the gangue falls off centrally. Several drums are normally used in series to produce a good concentrate grade. The machine makes a finished grade at -150 mesh from ore containing not more than 30% of -325 mesh material.

Very fine dust must be treated in an airborne stream. A device called the magnetic precipitator has been developed. The entering air travels in a helical path, dust being pressed against the inner rotating wall of a cylinder, while an outer system of stationary or rotating magnets induces a helical magnetic field. The magnetic particles move upward against a draught of air and at the top enter a weaker magnetic field and are thrown off, while tailings are blown down to a central discharge. All these machines have proved successful in pilot-scale runs, an Aerofall mill doing the dry grinding.

(20) *Historical*

19th Century Milling in Canada

A fascinating outline of the history of mineral dressing in Canada is given in the opening chapter of " The Milling of Canadian Ores," a substantial volume published in connexion with the Sixth Commonwealth Mining and Metallurgical Congress. L. E. Djingheuzian starts with Cartier's discovery of Canada in 1534, but milling did not seriously begin until gold was discovered in Nova Scotia in 1861. The first stamp-battery was erected at Waverley in the following year and by 1869, 55 of these mills were at work. In 1870 H. Y. Hind, reporting on the Sherbrooke Gold District, recommended the analysis of tailings as a means of improving recovery and in 1880 T. B. Hale erected a plant which concentrated gold and pyrite from dried tailings by air jigging. In 1887 Frue vanners were used to concentrate the amalgamation tails from stamp-batteries at Mount Uniake. From this it was a logical step to extend the new treatment to low-grade ores. In 1890 a chlorination plant was started in the Waverley district and was followed in 1897 by one handling 1,000 tons monthly in Malaga district. Meantime it was becoming clear that the gold which was not free was largely lost as tailings through being locked in pyritic minerals. In 1898 a Wilfley table went into the Richardson flow-sheet for tailings concentration. The same year also saw the first base-metal mill at work on an auriferous galena in Nova Scotia. The flow-sheet included a jaw-crusher, rolls, trommels, and jigs. In 1899 blanket strakes were used at Crow's Nest mill and the possibilities of the McArthur-Forest cyanide process were under consideration. Thus at the turn of the century Nova Scotia had a trained body of mill operators.

In the meantime much had been happening in British Columbia. In 1852 gold was discovered at Mitchell Harbour. In 1855 placer gold was found at Pend d'Oreille and by 1860 rockers and sluice-boxes were common along the Bridge and the Fraser rivers. The prospectors thus attracted reached the Yukon by 1869. Several arrastres were constructed, but standard equipment for hard-rock milling was based on stamps, amalgamation, and vanners to re-treat tailings. A chlorination plant was built by the Provincial Government at Barkerville in 1888 and converted to cyanidation in 1896. A report from the Ministry of Mines in that year recognizes the importance of fine grinding of the concentrated sulphides. In 1898 and 1900 two cyanide plants went to work, but the gravity-cum-amalgamation methods, costing less than a dollar a ton treated, still dominated

the scene. Copper was first found in B.C. in 1865 and argentiferous galena later. Lead and silver production began in 1887 and copper in 1894, the crude ore being smelted direct in the U.S. An import duty by America accelerated the construction of concentrators, of which there were ten by 1900. The typical flow-sheet used jaw crushing, rolls in series, trommels, jigs, classifiers, and shaking tables. Stamps were not employed.

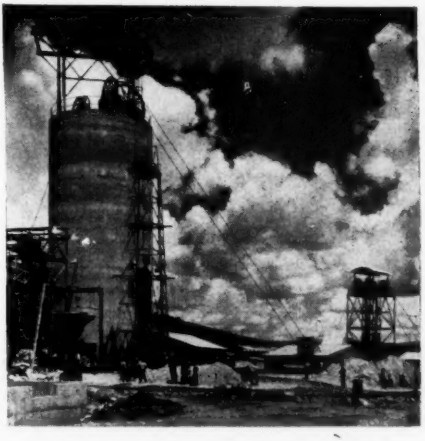
Ontario had been mining since 1844, over 3,000,000 dollars worth of copper being won from Bruce Copper Mines between 1846 and 1876. Copper milling appears to have commenced here in 1860 using rolls and jigs. Next door Wellington started crushing in 1860 and a roast-and-leach process in 1872, which proved uneconomic. In 1866 the Silver Islet mine started and in 1874 the manager, W. B. Frue, invented the Frue vanner. The Sudbury ores were found in 1883 but not concentrated till 1900. Ontario's approach to milling was more unconventional than those of Nova Scotia and B.C. and the Frue vanner was not the only novelty although it provided the only notable success. Mill tests began in 1895 with a laboratory at the School of Practical Science in Toronto and the School of Mining in Kingston went still further with test equipment in 1896. The first Paper on gold milling was presented in 1897 by J. E. Hardman to the Ontario Mining Institute. Bromocyanide is first recorded in Canadian use in 1896 for treating Deloro's arsenopyrite. Ontario's progress was mainly at a loss in the 19th Century, the low-grade gold ores rarely paying the wages bill. This was recognized as a challenge to be met by better milling and led to hard thinking.

Gold was discovered in Quebec in 1834 on the Gilbert River. In 1863 Golconda erected a stamp mill to work quartz veins near Sherbrooke, but the venture failed. Another attempt, on the Chaudiere, failed similarly, apparently because of the inexperience of the mill operators. Altogether gold had a chequered career. Galena had been found in 1686 on the east shore of Lake Temiskaming. In 1850 this deposit was rediscovered and later became the Wright mine. Milling began in 1885. Copper production began at the Eustis in 1875, concentrates then being hand-picked. Jigs were first used in 1889. The world-famous asbestos deposits were first mined in 1878. Crushing plant started up in 1888, but the methods tried, which included wet treatment, failed until in 1893 G. R. Smith found ways of fiberizing the material. Some chromite was being concentrated in the Coleraine area by the end of the century. In Quebec, as in the other Provinces, the first lessons in milling were learned the hard way. The most spectacular event was the Klondike gold rush following the discovery of Bonanza Creek in 1896. Crude sluicing methods were used to treat the rich gravel. Now, in 1957, dredging works profitably on alluvials as low as 11 cents/ton.

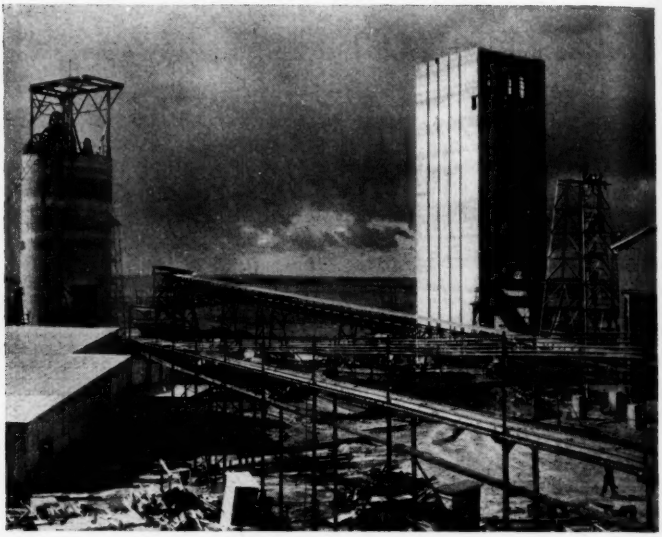
Dr. Djingheuzian's account goes on to the early '20's and thus brings in the early days of the flotation process. We take so much for granted to-day that it is good to be reminded of the growth of the mighty industry of mineral dressing from such sketchy beginnings in so short and recent a time.

Progress at Western Deep Levels

At the end of the March quarter Western Deep Levels, Ltd., had sunk the No. 2 and No. 3 ventilation components of its two Twin-Shaft systems to respective depths of 477 ft. and 1,099 ft. At the two hoisting components work continued on completing installations preliminary to sinking proper—as, for example, collar construction in one case, erection of the reinforced-concrete rectangular headframes, installing sinking hoists at No. 2, and commissioning similar hoists at No. 3. In both systems the ventilation components are circular 18-ft. diameter units equipped with circular reinforced-concrete headframes.



Ventilation Headgear and Tower.



Headgears and Concrete Conveyor.

The two hoisting components are 24-ft. diameter circular shafts.

Both these shaft systems are to be sunk from surface to a depth of 6,200 ft. to facilitate opening-up the Ventersdorp Contact Reef horizon. Later the sub-vertical components will be put down, possibly to a depth of 12,000 ft., to facilitate development on the Carbon Leader Reef. It seems that both shaft components will be used for hoisting. The permanent hoists are expected to be of the recently invented multi-rope, multi-layer friction-type double-drum Blair type. A twin-haulage or drive will probably be driven from workings in the No. 5 West Driefontein shaft area into the Western Deep lease area to contribute to the initial development and provide supplementary ventilation.

In each of the four shaft components now being sunk a multi-deck sinking stage is being employed, moved by a Blair multi-rope stage-hoist. Hand-lashing (or mucking) is applied in the ventilation components. In the two hoisting components lashing or mucking will be carried out by 20-cu. ft. air-operated cactus-type grabs attached to the lowest deck of the stages. The broken rock is to be discharged into 6-ton kibbles or sinking-buckets in the ventilation components and into 8-ton buckets in the hoisting components. At each of the four shaft sites a bore-hole is being put down to facilitate precementation ahead of sinking in order to seal off water-bearing fissures and probably also to consolidate broken ground. Sinking and lining will be concurrent, followed by equipping, including the fitting of 15-ft. centre steel buntons.

The Twin-Shaft systems at Western Deep Nos. 2 and 3 are situated in the eastern section of the lease area of 6,864 claims, where the reef horizons lie at shallower depths. In the indicated sub-outcrop zone of the Ventersdorp Contact Reef, which strikes diagonally from north-east to south-west across the lease area, the bore-hole depth of the reef ranged from 4,988 ft. in the north-east to 5,203 ft. in the south-west and the values from 106·1 in.-dwt. to 715 in.-dwt. No reliable estimate is possible of the average grade of ore that will be drawn from this horizon, but it may be of the order of 6 dwt. to 9 dwt. a ton. The bore-hole depth of the Carbon Leader Reef ranged from 7,401 ft. on the eastern section of the northern boundary to 10,266 ft. in the south-west section, about half-way between the northern and southern boundaries; the bore-hole values ranged from 48 in.-dwt. to 4,338 in.-dwt. While an accurate assessment of the Carbon Leader Reef grade does not seem possible from available information, it is possible that the average for the lease area may exceed 17 dwt. over an assumed width of 42 in. on the assumption that satisfactory persistence occurs throughout the lease area. Taking account of tonnages to be milled eventually

from both horizons it seems that the average reduction plant yield can be expected to be about 10 dwt. to 12 dwt. a ton.

The reduction plant is scheduled to be commissioned in 1963–64, perhaps slightly earlier, with an initial capacity of 100,000 tons monthly, subsequently to be expanded to 200,000 tons.

The two photographs reproduced here show, first, a view of the 18-ft. diameter ventilation component at No. 3 shaft system, with its reinforced-concrete circular headframe. To the front right of this is the derrick of a precementation drill, while on the extreme right is the compensation tower of the Blair stage hoist. The second photograph gives a composite view of (left) the circular reinforced-concrete headframe of the 18-ft. diameter ventilation component of the No. 3 system and (right) the rectangular headframe (under construction) of the 24-ft. diameter main hoisting component, to the right of which is the derrick of the precementation drill. The gantry between the headframes carries a belt-conveyor transporting concrete to the site of the headframes. Leading-in from the right foreground are service columns, including pipes to the precementation pumps.

Engineering Log

A new approach has been made to water conservation in the semi-arid lands of western North America ; it involves the concept of the " snow reservoir " built on the mountains. Of Colorado's area 3½% only lies in the alpine zone beginning just below the timber line, yet this supplies 20% of all the run-off water in Colorado's streams, which, in due course, become the main suppliers of the agricultural flat lands. Winter gales blow much snow into deep crevasses where it lies many feet deep and in due course melts to provide a tumultuous run-off in the spring. To slow down this run-off and thus to make the water more available for irrigation and city use a start was made with experiments designed by forestry specialists. They experimented with cutting the forest into patterns which would permit more snow to fall to the ground while yet leaving shade to prevent the sun melting it too rapidly when spring returns. By this they proved that the run-off could be increased by 20% or 30% from a forested slope correctly treated ; this has become known as " Operation Wet Blanket." Attention is now being turned to the huge snow reservoirs formed in the crevasses in the high mountains, any one of which may contain many millions of gallons of water. Two types of experiment are in use, the first using high snow fences in the lee of which snow drops, the second covering the accumulated snow with sawdust, which slows down the rate of evaporation and melting. In a comparative case uncovered snow had lost 6 ft. of depth while that covered with sawdust had lost only 2¾ ft. and the water had been conserved until late summer when it was most needed. Ordinary sawdust has the further advantage of being cheap and available in much of the area.

* * *

Time measurements of thousands of years have to be taken into account in geology, such immense forces being involved that relevant conditions cannot be readily reproduced in a faithful way in the laboratory. This means that laboratory experiments are seldom basic factors of research. What is claimed to be a useful method of research has been worked out at the Geophysical Institute of the Czechoslovak Academy of Sciences. This has made possible the laboratory measurement of the speed of propagation of earthquake shock waves in different kinds of rocks and shows what changes occur when these waves pass through different media. To date such knowledge has been gained from seismograph readings during actual earthquakes or in connexion with the detonation of large explosive charges in selected spots. The experiments are conducted with an ultrasonic apparatus designed by K. Klíma, L. Waniek, and Z. Pros, an electronic section creating electric pulses, which, by means of piezoelectric crystals, are changed into ultrasonic waves. These traverse rocks according to the same laws as in real earthquakes and lend themselves to use in research with models. After passing through the rock samples the waves are picked up by a piezoelectric element and transformed into electric oscillations which can be registered on the screen of an oscilloscope. The time taken by the ultrasonic waves in passing through the samples is measured and from data assembled by this method the speed of propagation of shock waves is calculated. The apparatus has the further advantage that it can be used in connexion with mineralogical prospecting, it is stated.

* * *

The London Planetarium, as a separate concern from Madame Tussaud's, the

adjoining owners, opened on March 19 with a programme of 35 weekly presentations, each lasting 40 min. This is the 33rd Zeiss planetarium since 1924 and the first in the Commonwealth; it incorporates important improvements. The dome-shaped building has an outer shell of copper covered with concrete and an inner one of aluminium. These rest on a 24-in. concrete floor supported by 12 columns each supporting 145 tons. The building is near the Metropolitan Railway, whose tunnel comes within 6 ft. of road-level, but piles, four to each column and 45 ft. long, go down 10 ft. below that level. A rail curve adds to the vibration but the effect, although noticeable in the original Tussaud basement 150 ft. distant, is negligible at the 30 ft. which separates the line from the edge of the planetarium. To achieve this, a heavy spider's-web pattern of concrete beams connects the pile caps and further weight is given by an 18-in. concrete floor at ground level. The optical projector is carried on a lift controlled from the lecturer's console together with the lighting and other features. Realistic night-sky background lighting is simulated by lights which give auroral glow and silhouette the plywood profile of London's skyline and "sunrises" and "sunsets" can be laid on. The auditorium seats 550 and, with its ancillary library (now under construction) and other services, is planned to educate as well as to entertain as it works up to its full programme.

* * *

A progress report was recently issued on the first year's experimental work at Cambridge connected with the development of a flexible oil container which could be towed through the ocean. This work was stimulated by the Suez crisis and by the increase in the cost of constructing tankers. The project would call for the transport of oil in a flexible tubular bag which when empty could be wrapped into a small bundle. Prototype experiments at Cambridge were followed by tests of 50-gal. tanks in the ship-towing tank at the National Physical Laboratory at Teddington and this has now progressed to larger work on the River Ouse. The containers are made of some such material as nylon which weighs less than one two-hundredth of the cargo it carries. Such a container lies 80% to 90% submerged and some of the difficulties of towing have already been overcome. One model, about 10 tons loaded, is 67 ft. long and 3 ft. diameter and when empty packs into the back of a car. It rides easily enough in harbour. Tests with small models would now appear to have arrived at the point where larger and larger sizes must be experimented with before the full possibilities of this mode of transport can be envisaged. There are, of course, applications for small containers beside their use for transporting oil from the Middle East. Any scrutiny of the road traffic in bowsers will show the tremendous importance of transport of liquids in bulk in modern industry and the advantages of our sea-girt island with its canal system are no doubt in the minds of experimenters. The cost of a container seems to be of the order of one-seventh of that of a tanker for similar size, but it must also have a towing ship and the overall efficiency of the system would probably be less than that of a tanker which incorporated its own propelling units.

* * *

The Burgess-Manning water separator snubber was originally designed to provide dual-function exhaust-gas silencing and removal of all seal water from the exhaust of vacuum-sealed pumps. However, at the National Advisory Committee for Aeronautics Lewis Flight Propulsion Laboratory, Cleveland, Ohio, a special problem arose in connexion with the silencing of discharge from two 8-cylinder compressors of 40-in. bore and 14-in. stroke, used to drive exhaust air from a closed chamber into the atmosphere. Oil from the discharge of other vacuum pumps had caused trouble. Plans to overcome the problem at first called for an exhauster head on top of the silencer, into which water was to be sprayed to remove the oil from the air stream. The need for the exhauster head was eliminated, after an engineering study, by the purchase of a water separator snubber measuring 9 ft. in diameter by 35 ft. in height. This installation handles up to 100,000 c.f.m. of air and separates up to 1,200 g.p.m. of water from the exhaust stream. Water is introduced in the inlet nozzle of the separator and is used to wash all oil out of the air stream. Oil and water then drop into a sump below, where oil is separated by an overflow device and water is left in a condition for recirculation. This method is close to 100% effective under normal operating conditions and essentially no maintenance is required. The solution of this problem is an interesting example of the way in which an installation can be adapted to different purposes.[1]

[1] *Power Engg.*, Mar., 1958.

News Letters

VANCOUVER

May 6.

Cominco.—The Consolidated Mining and Smelting Co. of Canada, Ltd., has reported a net profit of $18,815,382 for 1957, after providing for income and mining taxes and depreciation of plants; regular and surplus dividends during the year involved distribution of $22,113,425. The company's products consisted of 144,017 tons (all reference to tonnage is in short tons) of lead, 189,295 tons of zinc, 95,403 oz. of gold, 10,877,532 oz. of silver, 901 tons of cadmium, 73 tons of bismuth, 758 tons of antimony, 630,622 tons of solid fertilizer, and 34,154 tons of liquid fertilizer. By far the greater part of the end-product resulted from the mining of 2,423,577 tons of ore in the Sullivan mine, as compared with 2,769,177 tons in 1956. The decrease was due to the closing of the low-grade open-pit operation in May. Mr. R. E. Stavert, the company's president, who says that operations at the mine and mill were generally satisfactory, reports that underground development and backfilling were maintained commensurately with extraction. A pilot flotation mill within the main concentrator was commissioned during the latter part of the year, with a capacity of 100 tons daily.

The company's Bluebell mine, at Riondel on Kootenay Lake, produced 256,118 tons of ore as compared with 252,523 tons in 1956. The flow of thermal water encountered in the lower levels of the mine in the previous year was brought under control, but development at depth has been delayed and some modification in mining practice will be required. Production at the H. B. lead-zinc mine, at Salmo, increased to 451,381 tons from 435,305 tons in 1956.

The copper-lead-zinc mining and milling operation of Tulsequah Mines, Ltd., was closed in August last because of low metal prices and this subsidiary company has since been placed in voluntary liquidation.

The Con mine, in the North-west Territories, milled 174,157 tons of ore averaging 0·50 oz. gold per ton in 1957, as compared with 180,345 tons grading 0·54 oz. in the previous year. The adjoining property of Rycon Mines, Ltd., also a Cominco subsidiary, produced 9,757 tons averaging 0·84 oz. gold per ton in the last two months of the year, when production was resumed after a period of development.

No work was done at the Pine Point lead-zinc property, south of Great Slave Lake, principally because exploration to date has proved an extensive ore deposit that can be brought into production when desirable. Better metal prices and transportation facilities will be an important consideration as regards Pine Point.

The phosphate mines in Montana operated to the satisfaction of Cominco management, while the Trail smelter paid $14,045,133 to shippers of 68,663 tons of custom ores and concentrates. In view of market conditions, production of solid fertilizers was limited to 630,622 tons, as compared with 673,044 tons in 1956. Production of liquid fertilizers at 34,154 tons was substantially greater than the 1956 output of 20,449 tons.

In the company's annual report, Mr. Stavert states in part :—

> While there was a slight increase in sales volume over 1956, the average price received for metals declined substantially. The decline in metal prices, together with somewhat lower prices for fertilizers, resulted in lower earnings for the year. Labour rates were higher compared with 1956; there was little change in prices for operating supplies. Inventories of raw materials and finished products were somewhat higher at the year-end compared with that of the previous year.

Greenwood.—Highland-Bell, Ltd., produced 716,546 oz. of silver, valued at $579,877, from 15,779 tons of ore grading 45·41 oz. silver per ton during 1957. The value of by-products was: Lead, $46,407; zinc, $22,573; gold, $12,256, and cadmium, $2,517, bringing the gross value of production to $663,630; additional income of $18,495 came from interest, dividends, and from miscellaneous sources. Operating expense included $63,607 for ore-handling and marketing, $140,233 for stoping, $92,278 for exploration and development, $111,216 for milling, and $45,531 for head office expense and administration. After the provision of $25,347 for depreciation, $7,149 for Provincial mining tax, and $11,613 for income tax, the profit for the year was $185,152. Write-offs of $103,339 for outside exploration, $6,340 for option payments, and $999 for investment adjustment, after distribution of $78,293 in dividends, reduced earned surplus from $985,778 to $981,958. During the year the mill capacity was increased to 75 tons daily and the greater tonnage was reflected in the production value of $228,835 for the

final quarter of the year. The president of the company, Mr. Karl J. Springer, told the annual meeting of shareholders that net earnings were approximately $25,000 monthly and the company would pursue a policy balanced between the payment of dividends to shareholders and commensurate exploration, maintaining at all times a strong cash position.

Highland-Bell continued its aggressive outside-exploration policy in 1957. It acquired a one-sixth interest in the Mattagani Syndicate, which has outlined an orebody in northern Quebec with estimated reserves of 14,000,000 tons grading 0·016 oz. gold and 1·11 oz. silver per ton with 11·53% zinc and 0·66% copper. In partnership with Leitch Gold Mines, Ltd., Highland-Bell has taken a half interest in an iron prospect in north-western Quebec. Also in partnership with Leitch the company has acquired a half interest in a 98% interest in the Pick claims in New Brunswick.

Nicola.—Craigmont Mines, Ltd., has received a report dated April 8 from its consulting engineers, Chapman, Wood, and Griswold, of Albuquerque, New Mexico, in which Mr. E. P. Chapman, Jr., of that firm, has estimated partly-measured reserves of possible ore at 5,585,200 tons grading 2·26% copper on the basis of the first 15 diamond-drill holes. He states, in part :—

> In our opinion, these figures represent the total tonnage which can be partially measured from data presently available. However, only a portion of the body lying within the known limits of mineralization has been cut by drill holes and no allowance has been made for extensions. In a block limited by the known strike length, the indicated average width, and the known maximum exposed depth, there could be approximately 19,000,000 tons. The drilling programme now in progress will develop this block and demonstrate how much of it can be included in measurable ore reserves.

All work on the Craigmont copper-iron property is being directed by Canadian Exploration, Ltd., which holds a minority interest.

Nanaimo.—The Empire Development Co., Ltd., has resumed operation at its Quatsino iron mine, near the north end of Vancouver Island, and it is expected that regular shipments of iron concentrate will again be going forward to Japan in June. The operation is in debt to the extent of almost $6,000,000, a figure double that of the original estimate of the cost of reaching the production stage. The company has effected an agreement with its creditors and in future all mining, milling, and shipping will be done under contract by the Mannix Co., Ltd., Calgary contractors. Mr. Alex. A. Shaak, formerly resident manager of Empire Development, has been named project manager for the Mannix company.

New Westminster.—The annual meeting of Pacific Nickel Mines, Ltd., was advised by Mr. L. T. Postle, the president of the Granby Consolidated Mining, Smelting, and Power Co., Ltd., that the Western Nickel mill, at Choate, is now treating 700 tons daily. Copper concentrate is separated and shipped to the Tacoma smelter, whereas nickel concentrate is dried to reduce moisture to the specification of 4% before shipment to the Fort Saskatchewan refinery of Sherritt Gordon Mines, Ltd. The property, originally owned by Pacific Nickel, is now held by the operating company, Western Nickel, Ltd., which, in turn, is controlled by the Newmont Mining Corporation of Canada, Ltd., with 51% and the remaining 49% being held by Pacific Nickel. To finance the production $2,825,000 was borrowed from United States banks and a further $1,165,000 was advanced by Newmont, Pacific Nickel, and Sherritt Gordon. In addition the Granby company, which has contracted with Western Nickel to conduct the operation, has provided equipment to a value of $390,000 under a lease-option arrangement.

Skeena.—The annual meeting of Silbak Premier Mines, Ltd., was assured by the company president, Mr. A. E. Bryant, that it was the intention of the directors to resume production as soon as metal prices reached an economic level. The plans, formulated for the rebuilding of the concentrator following its destruction by fire in 1956, were necessarily deferred because of the subsequent decline in metal prices. The operating statement for 1957 shows income of $9,825 from interest and lists $116,666 as the year's proportion of use and occupancy insurance recoverable. Expense included $120,040 for operating cost and $78,087 for provision to meet funded debt. The resultant loss of $71,636 increased the deficit to $2,244,383. The balance sheet shows current assets of $245,747, against current liabilities of $46,576. Of the 4,000,000 shares of authorized capital, 2,810,000 shares have been issued. The agreement with Premier Border Gold Mining Co., Ltd., of May 1, 1956, through which Silbak Premier hopes to recover up to $175,000 for funds advanced in connexion with development work in the Premier Border mine, will lapse

late in 1958 unless Silbak Premier carries out mining operations during 1958. Negotiations are now being conducted between the two companies.

Vancouver.—What could prove to be an important discovery of germanium has been reported in the vicinity of the Powell River, 65 miles north-west of Vancouver. Taiga Mines, Ltd., a company originally incorporated to engage in copper mining on Vancouver Island, has staked 100 claims and is trenching and blasting in preliminary exploratory work. The germanium occurs in fossils in the sandstone and slates of the walls bordering two parallel creeks ; although disseminated to a large degree some assays have exceeded 1%. Outcrops in the creek walls indicate a minimum length of a mile for the deposit with a lateral interval of more than 2,000 ft. Dr. F. C. Buckland, Vancouver consulting geologist, is president of the Taiga company.

Nelson.—The annual meeting of Reeves MacDonald Mines, Ltd., was assured by the company president, Mr. Jens Jensen, of Spokane, that the company's mining and milling operation at Romac would be continued just as long as it was economically advantageous to do so. He said that retention of the operating staff, cost of maintenance, and deterioration resulting from idleness were important factors to be considered along with actual operating profit.

TORONTO

May 20.

Gold Production.—The output of the gold mines of Ontario for February included 210,646 oz. of gold and 35,370 oz. of silver, valued at $7,248,333, from 727,170 tons of ore milled.

Federal Mapping Programme.—The increased emphasis being placed on the development of Canada's northern lands is reflected in the 1958 field programme planned by the Department of Mines and Technical Surveys. In one summer 170 university students are to assist permanent departmental officials on a total of 83 field parties. The programme envisaged brings into play technical developments in transportation and in the field of electronics, making possible much wider survey coverage of difficult and extensive bush and muskeg areas. Actual experience on a project in northern Ontario with an electronic distance-measuring instrument has shown that a topographical survey task requiring a full week's work, using conventional methods, can now be accomplished with the same degree of accuracy in a day. The Canadian Hydrographic Service has also an extensive and varied programme on hand giving important assistance, among other projects, to the mineral industry by its charting activities, particularly in parts of Labrador, the Ungava Bay area, and the Belcher Islands in Hudson Bay. The Service will also carry on studies of the possible effects on tidal movements of the proposed Passamaquoddy Power Project and of the construction of a proposed causeway between New Brunswick and Prince Edward Island.

Porcupine.—McIntyre Porcupine Mines reports a gross income of $2,599,844 for the three months to March 31 last. After making all allowances the net revenue was $631,923, equal to 79 cents a share.

The report of Pamour Porcupine Mines for 1957 shows a profit of $9,978. In the year 628,509 tons of ore was treated, the bullion recovery being valued at $1,735,057. At December 31 last the ore reserves are shown as 1,636,975 tons assaying 0·1 oz. of gold per ton.

Nickel Refining.—At the annual meeting of the International Nickel Co. of Canada on April 30 the chairman said that 1958 marked the 40th anniversary of the beginning of operations at the refinery at Port Colborne. Its establishment in 1918, he stated, gave the company complete facilities in Canada for the production of nickel from ore to refined metal. Over the years refining capacity at Port Colborne had been repeatedly increased and, equally important, many process improvements had been achieved. The most recent improvement was the development of a new process for the electro-refining of nickel by direct electrolysis of nickel matte. The process eliminated high-temperature oxidation and reduction operations and permitted recovery, for the first time in nickel refining, of elemental sulphur and of selenium. The process is now in commercial operation in a section of the Port Colborne nickel refinery.

Sudbury.—Renabie Mines reports an output of $1,056,830 for 1957, recovered from 167,133 tons of ore treated. The net profit for the year is given as $49,080. Ore reserves at December 31 totalled 402,497 tons grading 0·212 oz. of gold per ton. The report states that capital expenditure last year included provision for installing new equipment and mill alterations incidental to

changing the grinding system from steel balls to rod- and pebble-mill grinding. This work has been completed and there will be a gradual increase in the mill rate from 450 tons per day to 550 per day.

Blind River.—In his annual address to shareholders the president of the Rio Tinto Mining Co. of Canada said that the current year should be significant for the uranium mining operations the company manages. Some mines are already producing at their rated capacity, he said, and it now seemed reasonably certain that the goal of scheduled production would soon be reached at all the others. These are Algom's two mines, Nordic and Quirke; Milliken Lake; Northspan's three mines, Lake Nordic, Panel, and Spanish American; Pronto and Rix Athabasca. With total uranium oxide output from these properties running at an annual rate of about 7,500 short tons the company would be responsible for about 60% of the output of the Blind River area and about half the production scheduled for the whole of Canada. Research and engineering studies were also continued at the pilot plant of the recently-formed company—Rio Tinto-Dow—on the thorium and rare-earth deposits of the Blind River area.

Cochrane.—The results of an aeromagnetic survey conducted for the Ontario Department of Mines were released on May 13. The maps now available comprise 18 sheets, each on a scale of 1 in. to ¼ mile, covering approximately 1,000 square miles. The Cochrane area which lies to the south of Kapuskasing covers the following townships: Staples, Casselman, MacVicar, Carmichael, Fenton, Slack, Stringer, Ford, Seaton, Griffin, Hicks, Oke, Wilhelmina, Geary, Kirkland, Kingsmill, Laidlaw, Mabee. The price of individual sheets is 50 cents per copy and they may be obtained on application to the Publications Branch, Ontario Department of Mines, Parliament Buildings, Toronto.

Manitoba.—The Hudson Bay Mining and Smelting Co. reports a net profit of $8,093,303 for 1957, as against $21,007,852 for the previous year. This reduction is chiefly due to lower metal prices, sales in 1957 yielding $41,417,371 as compared with $61,030,963 for the previous year.

The accounts of Sherritt Gordon Mines for 1957 show a profit of $5,350,000. Ore treated at the Lynn Lake property during the year amounted to 833,443 tons, an increase over the 749,506 tons handled during 1956. Ore reserves at the end of the year were 13,640,000 tons, grading 1·06% nickel and 0·56% copper. Production of nickel and ammonium sulphate showed increases. The nickel output, amounting to 20,067,000 lb., refined at the company's Fort Saskatchewan plant, compared with 19,239,648 lb. in 1956. Ammonium sulphate output in 1957 was 94,786 tons and in 1956 70,651 tons.

Quebec.—Gold production in Quebec Province for 1957 totalled 1,006,814 oz., valued at $33,768,543, as compared with 1,037,060 oz., worth $35,692,233, for the previous year. The silver output for the year was 3,651,087 oz., against 4,063,504 oz. for 1956, while copper shipments declined from 244,559,468 lb. to 227,655,849 lb. and those of zinc from 171,945,511 lb. to 149,365,834 lb. Asbestos shipments, however, were up to 995,011 tons from 967,145 tons.

The report of the Quemont Mining Corporation for 1957 shows that the operating profit after taxes amounted to $2,501,795 as compared with $4,931,850 in 1956, while the net profit after provision for depreciation amounted to $1,497,882 as compared with $3,674,030 in 1956. Earnings during the year were seriously affected by the decrease in prices for copper and zinc, the high rate of discount on the U.S. dollar, and increased marketing and mine operating costs. After milling 837,231 tons of ore, the reserves at December 31, 1957, showed a decrease of 550,000 tons as compared with a year ago.

Aluminium, Ltd., reports a net income of $5,330,884 for the three months' period ending March 31, 1958, as compared with $14,958,991 for the corresponding period of 1957. The Aluminum Co. of Canada, Ltd., whose accounts are consolidated with those of Aluminium, Ltd., reports a net income of $4,517,020, compared with $11,034,318 for the first quarter a year ago. Aluminium, Ltd's consolidated sales and operating revenues for the quarter were $101,600,000, as compared with $122,800,000 a year ago.

MELBOURNE

May 20.

Gold.—There is a prospect that despite the unsatisfactory price for gold the heavy depression in the base-metal market may direct more attention to gold mining, particularly as it has the attraction of tax-free profits and dividends. Some recent move in this direction is shown by the formation of the Eclipse Gold Mining Co.,

in Western Australia, to work a mine at Mount Magnet, which contains as yet small ore reserves of good grade. Another small company is now prospecting at Burnakura, north of Mount Magnet, and the prospecting shaft is going down in good values. This company is Hill 50 Consolidated, which was unsuccessful in its work on the Mount Magnet field during the boom which followed the sensational rise of the Hill 50 Mine. The revival of Consolidated has been followed by the purchase by Hill 50 Central, another of the Mount Magnet field floats, of the King Solomon mine at Edwards Find. This mine is equipped with mining and treatment plant and it is reported that some production has been achieved. At Sandstone the old Black Range mine is reported as being re-opened. This mine was discovered in 1898 and became known as the Golden Hole, producing 155,000 oz. of gold from 156,000 tons of ore; the mine has been abandoned for some 40 years. The field at that time had a rather high reputation in the State. Although these new operations may be small-scale they point to some revival of interest in gold. There has also been some increase in activity by prospectors and working parties in Western Australia, which is the leading gold-producing State.

Great Boulder holds a high position amongst the Kalgoorlie mines and the following figures are interesting. Ore treatment on the mine commenced in 1895 and in the first year 3,000 tons of ore yielded 25,000 oz. of gold. Since then the mine has been in continuous production and in a period of 63 years 14,000,000 short tons of ore have been milled for the recovery of about 6,000,000 oz. of gold valued at £A44,000,000. Dividends paid have amounted to about £A9,000,000. In recent years great attention has been given to the location and development of the minor lodes, passed over in earlier years because of their relatively small size, but which now make up a large proportion of the ore reserves, which are estimated at over 2,000,000 tons with an average grade of 5·5 dwt. gold per ton. Underground work has reached the 3,000 ft. horizon, with no diminution in the normal grade of ore. Development continues to be very successful and ore reserves are more than maintained against an annual production of 500,000 tons, from which gold recovery approximates 125,000 oz. valued at some £A2,000,000. The importance of the mine to the town of Kalgoorlie and to the State may be gauged from the distribution of nearly £A1,000,000 in wages per annum and the expenditure of about £A500,000 in stores. On present indications the continuance of operations on the present scale for a considerable period appears assured, a view which is supported by long-range geological opinion applied to the whole field. Costs at this mine and on the whole field are very creditable and increased efficiency, year by year, has met the steady rise in wages and the price of stores, which is the inevitable result of the periodical increments in the basic wage. Profits are maintained despite the continued inadequate fixed price for gold.

Gold production in New South Wales will receive a set-back by the closing down of the dredge of Wellington Alluvials, Ltd., on the Macquarie river. The company, in which the Broken Hill Proprietary Co., Ltd., is largely interested, is to cease work at the end of May and the company will probably be wound up. A boring campaign has been extended ahead of the dredge and the disappointing results have brought about the decision to close down. Even beyond this proving it is considered that operations will be unprofitable. The company was promoted by Broken Hill more than 20 years ago and has worked with varying success, work being interrupted by the war and, more recently, by recurring floods. Two years ago the net profit was £A56,800, but last year's operations resulted in a loss of £A5,312 caused by higher costs and lower grade ground. The company has paid a total of £A229,167 in dividends on a paid capital of £A250,000.

Oil.—An agreement has been approved by the South Australian State Government for an oil exploration programme estimated to cost £A1,330,849, following the approval of an agreement between Santos, Ltd., an Australian company which has carried on extensive prospecting in northern South Australia and south-western Queensland, and an American company, Delhi-Taylor Oil Corporation, of Texas. Amongst other work the latter company has undertaken to sink to a depth of 14,000 ft. in the deeper part of the Great Artesian Basin. The work done by Santos in the past two years has been interesting; showings of light oil have been met and in some parts there have been intersections of a waxy petroliferous substance. The search has extended from the Lake Torrens Basin toward Oodnadatta and into the south-western corner of Queensland.

Iron Ore.—There is considerable satisfaction in South Australia over the decision of the Broken Hill Proprietary Co. to expand its iron-smelting operations at Whyalla into a steel industry at a cost of £A30,000,000. At the present time the company's mines on the Eyre Peninsula (Iron Knob and Iron Monarch) have supplied the steelworks in New South Wales, supplemented by the output of the mine at Cockatoo Island, Yampi Sound, in Western Australia. With the increasing Australian demand for steel the company is re-opening the Iron Baron mine, also on the Eyre Peninsula. The establishment of the steel industry in South Australia will call for additional supplies of iron ore and this may be met to some extent by locations reported by the South Australian Government as the result of a Government drilling campaign which is stated to have disclosed some 30,000,000 tons of high-grade ore outside the leases held by the Broken Hill Proprietary Co. To meet the demands of the more distant future attention is being given by the company to the extensive deposits of low-grade material existing on the leases. Research is being carried out into its utilization and it is reported that a plant will be erected as a first stage toward its large-scale treatment. It has been forecast by the Premier of South Australia that a commercial plant with a capacity of 1,000,000 tons of material per year might be in operation within 10 years. This plant would be the second phase in the establishment of the steel plant at Whyalla.

Bauxite in Western Australia.—The Western Mining Corporation, Ltd., may test bauxite deposits in the Darling Ranges between Collie and New Norcia. There is a number of occurrences of laterite in this area but all are not of commercial quality. No firm plans have yet been made and consideration has, so far, been given to prospecting only. The company's ultimate intentions are unknown, but it seems that other interests are considering the expansion of the aluminium industry in both Queensland and New South Wales. The growth in the use of aluminium in industry is a threat to the utilization of copper and this threat may have influenced the depression in the copper market to some extent.

Natural Gas.—The Australian Oil and Gas Corporation has been drilling in country within a distance of 50 miles of Sydney, New South Wales, with the object of locating a commercial supply of natural gas that could be used in the industries of that city. In the No. 4 bore at Camden a flow of gas was met which gave a volume of 90,000 cu. ft. per day; gas was also met in the No. 1 bore and a flow from the Dural bore at the rate of 20,000 cu. ft. per day. These developments were considered sufficiently important to warrant obtaining expert opinion and Dr. Glenn G. Bartle has accordingly inspected the areas. He considers that the showings of gas are encouraging and that the prospects are favourable for the location of gas in quantity adequate for commercial purposes.

Mary Kathleen Uranium.—It is expected that the treatment plant on this large North Queensland uranium mine will be ready to commence work about the middle of the year and if anticipations are realized it will be a remarkable achievement in the time, for two years ago the uranium occurrence was an undeveloped prospect. The total expenditure on the project, when completed, will be close to £A13,000,000. Ore reserves so far proved are regarded as more than sufficient to fill the initial contract for the supply of uranium oxide to the British authorities. Water supply for plant and town is an important factor in the semi-arid region and it has been reported that the recently-completed dam on the Corella river is leaking through small fissures in the surrounding country but not through the dam face. Divers are working to locate the localities of the leakages. Water consumption will approximate 1,500,000 gal. per day when the mill has commenced operations; it is therefore very important that the dam be filled before the end of the present wet season, for rain falls only in the three months or so of the wet season.

Superphosphate Production.—Artificial fertilizers, particularly superphosphate, are very important in the Australian economy in all forms of agriculture and also in pasture improvement. In the superphosphate industry the rock is imported from Nauru and Christmas Islands. Sulphuric acid is manufactured partly from imported sulphur and partly from Australian sulphide ores and concentrates in about equal quantities of each. There is considerable agitation for the reduction in the use of brimstone and an increased consumption of pyrite, for an increase in the latter would be of great importance to the copper-mining industry, which at the present time cannot sell sufficient tonnage of its by-product pyrite

concentrate to compensate for the low price of copper. The demand for superphosphate is increasing and there is ample acid-making potentiality in the country's pyrite resources, but the easier utilization of brimstone over pyrite gives a definite advantage. This does not arise when superphosphate works are situated near metallurgical plants where the gases from concentrate roasting plants are readily available for acid manufacture. Electrolytic Zinc Co. of Australasia, Ltd., at Risdon, Tasmania, is finding difficulty in meeting the demand for superphosphate in Tasmania, its acid being manufactured from gases from the roasting of zinc concentrate. Previous maximum delivery of superphosphate from the Risdon works was 86,000 tons in the year. The demand in this financial year is expected to exceed 100,000 tons, which, however, is only a small part of the consumption on the mainland, largely in the wheat-growing industry. The company is spending £A200,000 on improvements in production to meet the higher demand which is expected to continue.

King Island Scheelite.—At the recent annual meeting of this company the chairman said that it is not possible to produce at a profit at the present low price for tungsten and dividends comparable to those of the last few years cannot be expected; the dividend policy therefore cannot be predicted until the position becomes more stable. The mine will continue working for the present. The company's resources have been consolidated during the boom period and the financial position is sound. The company, in conjunction with United Uranium and Loloma (Fiji) Gold Mines, is prospecting the Maranboy tinfield in the Northern Territory; developments have been satisfactory so far, but it will be 12 months or more before an assessment of the potential of the field is possible.

FEDERATION OF MALAYA

May 6.

Radioactive Minerals.—A report by the Canadian team which has concluded an aerial survey of about one-third of Malaya suggests the probable existence of radioactive minerals in Pahang State. The Geological Survey Department in the Federation is now organizing field work to prepare the way for confirming the new mineral wealth indicated. Dr. J. B. Alexander, Director of the Survey, has said that the report will give his department at least 10 years' hard work, just to seek to confirm the findings of the aerial team which cost the Canadian Government about (Malayan) $640,000, under the Colombo Plan, and the Federation of Malaya Government $400,000. It is agreed, however, that the aero-magnetic survey has tremendously advanced knowledge of Malayan geology.

Iron Ore Production.—Iron ore production in the Federation of Malaya last year totalled 2,972,359 tons, an increase of 527,789 tons over the total for 1956. Last year's amount was the highest produced since the war. Exports of iron ore from Malaya last year came to 2,919,737 tons, an increase over the previous year's total of 543,324 tons and also a record. Japan bought the bulk of the ore, the Netherlands 24,968 tons, Formosa 18,000 tons, and Thailand 110 tons. However, Malaya's iron ore output in December last was well below the average monthly production figure, mainly due to bad weather conditions during the monsoon season in mining areas of the east coast. The month's output was 77,177 tons, against 168,211 tons for November.

Following the Japanese decision to cut iron and steel production this year Malaya's current ore exports are expected to suffer, but the latest report is that the reduction of Japanese imports of iron ore from Malaya is now expected to be "small". In the meantime the first shipment of iron ore from a newly-opened mine at Temangan, in the State of Kelantan, is being sent to Japan. A Japanese ship, the *Nichiziu Maru*, was due recently to load 16,000 tons of ore near Tumpat port. This mine, which began operating at the end of last year, has Malayan, British, and Japanese capital. It is expected to produce 350,000 tons of ore a year. Japanese machinery was installed and railway extensions were built to transport the ore to a new mechanized loading point about one and a half miles north of Tumpat.

Tin Industry.—As a result of the Restriction Scheme 100 tin mines, including eight dredges, have so far stopped production in north Malaya and about 3,600 persons have been thrown out of work in mines in Perak, Province Wellesley, Kedah, and Perlis. Before the scheme was introduced there were 497 mines at work including 41 dredges and employing 21,774 workers. Now there are 397 mines operating, with 33 dredges and 18,173 workers. All mines have cut down the

amount of work being done, resulting in fewer shifts, some mines being able to work an eight-hour shift only on certain days of the week. At the same time some mines have grouped together and arranged for their combined quota to be produced by one or two mines in the group; the others shut down.

The Restriction Scheme has also caused a drop in production at Malaya's only coal mine, at Batu Arang, during the first quarter of this year. From 9,751 tons in January, production fell to 6,600 tons in February and 5,765 tons in March, according to Malayan Collieries, Ltd.

Chinese miners in the State of Perak are to pay a smaller contribution towards maintaining the Kinta Valley Home Guard, which affords protection for their mines against attacks by terrorists. They are to pay (Malayan) $30,000 a month now and the Government the rest—$120,000. To facilitate this arrangement the Guard has been reduced from a strength of 900 officers and men to 650.

A tin dredge which sank in 30 ft. of water at Lahat, near Ipoh, 15 years ago has been refloated by a salvage crew from Singapore. The dredge, belonging to Pengkalen, was sunk in 1943 during the Japanese occupation. A crew from Singapore refloated the dredge after three and a half months' work on the task. George Cohen, Sons and Co., Ltd., had commissioned the job and the dredge is to be broken up for scrap.

A dam half a mile long is being planned to check the spread of old mining silt from the upper Gopeng River valley to the plains south of Gopeng, 12 miles from Ipoh. The dam is expected to cost about (Malayan) $150,000 and to be included in the Perak State Budget for next year. The present system of earth bunds erected to check the spread of silt is proving inadequate although is has been maintained by the State Government for the past ten years at an annual cost of about $15,000. Silt has accumulated through decades of mining and old mine tailings covering the whole valley floor to a depth of 400 ft. in some places have begun to erode extensively and silt is being slowly carried down the river. Channels spreading out from the river cause frequent floods.

Mr. P. Browne, the State Drainage and Irrigation Engineer of Perak, in the course of an article in the *Singapore Standard*, refers to river deviation projects by mining companies to enable them to mine tin in old river beds. He says the largest such scheme in the country is in Perak and involves a 25-mile deviation of the Kinta River below Ipoh. " It is being carried out by five mining companies ", he says, " and when completed will have cost about (Malayan) $14,000,000 or $15,000,000, all paid for by mining companies ".

Machinery Imports.—A 22-man Australian trade mission visiting Malaya has put up a strong case for contributing towards mining development. A supplement published in the Malayan Press said that at present lode-mining activity in Malaya was at a low level, a natural sequel to the many years of concentration on alluvial deposits, but that with the exhaustion of these reserves, which " is already becoming apparent ", attention would no doubt turn to underground orebodies, which would call for application of modern prospecting methods. With these techniques already developed to a high degree of efficiency Australia, it is claimed, is in a position to provide whatever assistance was required for the intensive investigation of Malayan mineral wealth.

Sarawak Bauxite.—Sarawak is soon to begin exporting bauxite from Sematan. The first shipment will consist of 6,000 tons to Formosa, which has ordered 50,000 tons. Announcing this in Kuching, Mr. Charles Schwander, technical director of Sematan Bauxite, Ltd., said it was only in September last year that work began in establishing the industry. In spite of 60 days of rain and difficulty of communications facilities necessary for production and export were completed. He expected that at the moment production would be about 30,000 tons a month. Besides being shipped to Formosa bauxite is to be exported to Japan.

India and Pakistan.—The Indian Atomic Energy Department has decided to set up a plant for production of uranium metal at Trombay, near Bombay, it is reported from New Delhi. Indian Rare Earths (Private), Ltd., which has been entrusted with the job of erecting this plant, has started work and it should be ready by the end of 1958.

The extent of uranium deposits in Pakistan is being surveyed by a team of experts, according to Dr. Nazir Ahmad, chairman of the Atomic Energy Commission, speaking in Lahore. He endorsed a UNESCO expert's statement that uranium deposits had been found in Hazara; the exent of the deposits had not yet been ascertained.

The setting up of an oil refinery as proposed for West Pakistan would probably result in the saving of a considerable amount of foreign exchange. A survey report for the refinery was submitted to the Pakistan Government by a consortium of companies, comprising Burmah Oil, Shell Petroleum, Standard-Vacuum Oil, and Caltex.

China.—As prospecting goes on the richness of China's mineral deposits becomes more and more apparent, it has recently been reported. Coal reserves, estimated a few years ago at 400,000,000,000 tons, are now put at two and a half times that figure; a single new field discovered in south-western Kweichow Province is estimated to contain 18,000,000,000 tons. Potential reserves of tungsten, molybdenum, tin, and antimony are now reckoned to be the greatest in the world. A big open-cut iron mine at Tayeh, to supply the Wuhan steel centre, 80 miles away, is taking shape.

Tin miners in Malaya were worried recently by news that China had arranged to export tin to Japan. Malaya, already hit by the Restriction Scheme, was now confronted by a competitor which was selling at a cheaper rate in the Japanese market—a market that imported 6,744 tons of tin from Singapore and Penang last year. However, the Koyo Bussan Company, a Japanese firm specializing in trade with China, was stated to have said that contracts made so far between Japanese and China were for only 500 tons of tin from China. A statement by the Yawata Iron and Steel Company, big tin consumer in Japan, expressed interest in China as a supplier of tin, especially if prices were low, but added that the amount of tin Peking could supply appeared to be limited.

JOHANNESBURG

May 16.

Union Affairs.—Satisfactory progress is being recorded in drawing up the specifications for equipment and installations including mechanical loading appliances required in the planning of Port Elizabeth as an ore export port. The specifications are expected to be completed within the next few months.

An international conference on the major occupational hazard of mining and certain types of quarrying—pneumoconiosis—is to be held in Johannesburg during February, 1959, at the University of the Witwatersrand. Under the presidency of Professor S. F. Oosthuizen and with Dr. A. J. Orenstein as secretary-general, the conference will review unpublished information about the hazard and discuss outstanding problems. Dr. Orenstein is director of the Pneumoconiosis Research Unit attached to the South African Institute of Medical Research.

The recent discussions between representatives of the Combined Development Agency (buyers of uranium oxide on behalf of the United States and British atomic energy authorities) and the South African Atomic Energy Board were primarily concerned with setting a ceiling on its purchases from this country. Resulting from the discussions the ceiling has been established at 6,200 tons of uranium oxide a year from July 1, 1958, and any available output above this maximum may now be disposed of elsewhere without approval by the Agency but still under licence or permit by the South African Board. The duration of the contracts under which the designated uranium producers are operating ranges between 1964 to 1966, but it has not been made clear whether the first or the last of the two years mentioned will be the end of the period of supply at the rate of 6,200 tons a year, or whether the supplies to the Agency will begin to taper off after the first date. All the other conditions of the contracts remain unchanged, including the price. No agreement was reached on the release of information additional to what has already been approved and data on actual extraction costs, prices paid or payable, and actual sales remain on the prescribed list. South African output of uranium oxide in in 1957 amounted to 5,699 tons and increased to the annual rate of 5,929 tons in the first 1958 quarter. The scope for further expansion of output is therefore limited under the contracts; indeed in some cases there may even be a slight scaling down of output, especially by those mines which recently expanded their plants and which cannot find other outlets than through the Agency. This adjustment or these adjustments will doubtless be effected through the Atomic Energy Board and possibly the Chamber of Mines.

There have been unofficial reports that illicit gold buying has increased to proportions which in the case of some mines has materially affected their returns.

Imports into South Africa in the first quarter this year were valued at £155,364,000 and exports at £101,390,000, against the

corresponding 1957 figures of £132,507,000 and £116,831,000. With the figures for the first 1957 quarter in brackets, individual items among exports for the first 1958 quarter were: Chromite £843,000 (£741,000); lead concentrates, £1,873,000 (£2,865,000); manganese ore, £1,767,000 (£1,390,000); bar and blister copper, £1,520,000 (£2,451,000); asbestos, £2,457,000 (£2,570,000); coal (mainly, it seems, anthracite), £432,000 (£354,000); diamonds, £9,097,000 (£10,664,000), and prescribed minerals, £14,400,000 (£10,619,000).

Transvaal.—Transvaal Gold Mining Estates is now progressively closing down its mining operations in the Pilgrims Rest, Lydenburg, and Nelspruit districts of the north-eastern Transvaal. The best method of disposing of the company's assets are now being considered.

Transvaal Consolidated Land and Exploration, which owns freehold and mineral rights over 111,872 acres and mineral rights only over 3,426,307 acres, an operating colliery in the Eastern Transvaal, and a wide range of gold and gold-uranium shareholdings, has extended its chromite interests through the acquisition of the Rooderand Chrome Mine, in productive operation as a wholly-owned subsidiary. While the mine of Platinum Prospecting Co. (Pty.), Ltd., remained on a caretaking basis, metallurgical tests on ore from the deposit were continued.

Durban Roodepoort Deep is still concentrating relatively greater effort to Kimberley Reef development, with satisfactory values and payability. The mine is extending the application of long-wall stoping at depth and with the reduced stope-block widths on strike.

City Deep, Ltd., which owns freehold in the vicinity of Johannesburg to an extent of 2,278·7 acres, has continued to re-organize its operations to effect, if possible, further economies. However, while the position has improved, the prevailing shortage of working faces renders grade control most difficult to achieve. At the mid-year operations are to be curtailed further, involving the conducting, reclamation, and extraction of pillars only in the shallower eastern section.

Consolidated Murchison, which held 2,916 base-metal claims at the year-end in the Pietersburg district, is extending this further by 172 claims in the Letaba district. In the March quarter exploratory drives on strike (east-west) were under way in two sections and were projected in three other sections in order to investigate ground lying between the presently-known major economic occurrences. One lens, between two of the major bodies, is to be explored through a vertical winze, being sunk, which has already disclosed payable reef in two crosscuts, but the strike-extent of the lens has still to be defined. Owing to the weakness in the antimony market operations more recently have been severely curtailed, including exploratory development. The Gravelotte section is at present supplying all the mill requirements and there development is several years ahead of treatment requirements.

The position at Western Reefs Exploration and Development is that an increased tonnage of higher-grade Vaal Reefs ore has been included in the ore reserves, the average grade of which has thereby been raised, but the tonnage declined relatively slightly due to the comparatively narrower width of the Vaal Reef and a reduced tonnage on the Ventersdorp and Elsburg horizons. Within the lease area primary development demarcating the payable extent of the Ventersdorp and Elsburg Reefs has largely been completed and opening-up operations on these horizons will apparently henceforth be advanced outside the present lease area to define the payable extent on which application for a lease will be based. However, the company regards as more important the extension of development on the Vaal Reef horizon.

Vaal Reefs Exploration and Mining has brought forward its programme of sinking the new shaft-system (No. 2) in the south-east section. Preliminary work has already been started at the site and the start of sinking has now been scheduled for early 1959. In the meantime two twin-haulage systems on two different levels are being driven to the new shaft area through a major fault zone. This will facilitate what is expected to be extensive reef development before the shaft reaches its final depth. The whole programme has been accelerated to provide the additional ventilation and hoisting capacity required to achieve a material increase in the milled tonnage.

South African Land and Exploration Co., Ltd., which owns the mineral rights over many thousands of acres in the Free State and Natal and mainly in the Transvaal, has considerably extended its producing gold mining property in the Brakpan area through the recent acquisition of the Withok property from the Union Corporation group. The Withok section is being explored through an

extension of an incline shaft in the deeper levels, which extension had been carried 3,600 ft. beyond the southern boundary by the end of 1957.

This year Brakpan Mines is to draw even more tonnage from surface dumps of development rock from earlier operations and accumulated sand residues previously not sufficiently reduced to permit of optimum leaching. This sand residue accumulation, which may be as much as 3,000,000 tons, will be reground and a flotation concentrate produced for further cyanidation. Overall working costs should be reduced further by treatment of greater tonnages of development ore and accumulated sands. On the mining side the massive nature of the Footwall Reef does not permit selective stoping to the same extent as on the less wide Main Reef Leader; consequently variations in values cannot be controlled to the same degree when, as is necessary, diluent footwall ore has to be mined with higher-grade tonnages in order to extract the latter.

Springs Mines is another mine supplementing tonnages mined from diminishing blocks of payable ore by drawing from surface dumps of earlier development ore, with benefits in working costs.

East Rand Proprietary Mines is finding that the crushing and milling sections are becoming obsolete and costly to maintain and that difficulties are being experienced in finding suitable operating staff, the consequent labour charges being too high. The best methods of overcoming these difficulties are being considered. New installations may therefore be planned.

Both Eastern Rand Extensions and Southern Van Ryn have secured small participations in the area east of the Stilfontein and Hartebeestfontein mines in the Klerksdorp zone, where drilling is being conducted by the Anglo-Transvaal group.

Marievale Consolidated expects to have completed extensions to its reduction plant to 92,000 tons a month from 72,000 by about the year-end.

Grootvlei Proprietary, which expects to develop a moderate tonnage of payable ore on the Kimberley Reef, has reduced the rate of development on the Main Reef, which has been conducted well ahead of stoping requirements.

Winkelhaak Mines has completed its reduction plant and will for the remainder of the year be conducting test runs and earning revenue therefrom pending the expected start of production at the monthly rate of 60,000 tons from early 1959.

Substantial barren zones within the lease area of Vogelstruisbult Gold Mining have been disclosed by exploratory development on both the essentially gold Main Reef and the gold-uranium bearing Kimberley Reef horizon. Areas where there is a reasonable prospect of locating payable ore are becoming increasingly restricted, especially on the Main Reef. Success has been achieved in examining zones where stoping has already taken place. However, ore reserves have declined and are expected to continue to decline.

Orange Free State.—St. Helena Gold Mines sank a borehole in the extreme east-central section which intersected a reef at 4,357 ft. between the Leader Reef horizon and the Basal Reef with values of 66 dwt. over 9·3 in. and the Basal Reef at 4,405 ft. with values of 27·09 dwt. over 39·5 in. The significance of the relatively much shallower depth than was expected indicated that in the area there is an upcast block of orebody, remote from present workings, which apparently justifies the sinking of a new shaft for its development. Consideration is being given to this.

A borehole drilled upwards from the haulage advanced from the northern Loraine mine into the lease area of Riebeeck Gold Mining intersected what may be an upper Elsburg Reef, with values of 12·93 dwt. over 51·1 in. before passing into Ventersdorp conglomerate. The borehole, situated between the sites of surface boreholes WN 3 and WN 5 in the northern section of the lease area is of interest because it is approximately in the centre of the payable Elsburg zone which drilling has defined as extending 25,000 ft. or somewhat more from BH 1 borehole (Farm Kromdraai 586) in the north to borehole ERK 1 in the south, with a lateral width of zone as indicated by drilling of about 1,300 ft. at its widest. The multi-banded reefs of the zone from 2 to 14 in the boreholes drilled lie at depths from 4,300 to 5,700 ft. below surface; values from trace to 5,306 in.-dwt. were disclosed averaging about 11·5 dwt. to 17 dwt. over an assumed width of 46 in. The future production yield has been estimated at about 7 dwt. a ton. The 26 ft. diameter No. 1 Shaft being sunk to a depth of about 5,800 ft., which should be reached by about mid-1959, is some 500 ft. north-east of borehole VDH 5, well to the south of the haulage borehole mentioned.

The shaft will be completed before reef development is initiated.

A committee has been investigating the disposal of underground water pumped to surface by the Free State mines and will submit proposals to the Government.

The programme of expansion previously projected by President Brand Gold Mining has been revised in order to achieve more balanced operations in more extended workings and to re-align future underground layout more in conformity with geological features especially on the common eastern boundary with President Steyn. This boundary will now be re-adjusted to conform more closely with the strike of the Arrarat Fault. Accordingly ground west of the fault will be ceded to President Brand and that east of the fault to President Steyn. President Brand is to sink its own twin-shaft system in the north-eastern section and Steyn a similar system in its south-western section.

Officially it has been stated that any future decline in the Brand mill-feed grade should be slight and gradual. Whether this still applies to the extension of operations now projected is not known. Drilling results in and close to the lease area indicated a grade range for the whole lease area from about 9 dwt. to 15 dwt. over 50·36 in., with the actual development average probably tending more to the upper limit. Any decline in the stope grade should largely be offset by increased surface sorting and beneficiation, while the higher milling rate should increase aggregate earnings, even after allowing for tax and lease payments.

In the case of Steyn the effect of extended operations on grade should not be marked and should be adequately counterbalanced by sorting and attendant beneficiation. At the higher milling rate earnings should be substantially improved, even after allowing for tax and lease payments. The only qualifying factor here would be the proportion of lower-grade Leader Reef ore included in the mill feed. However, mining policy will without doubt be based on a grade commensurate with the capital expenditure and structure of the company. Drilling results indicated a range of grade for the lease area of 6 dwt. to 7·5 dwt. over 44·25 in.

It would appear that the east-west dip of the reef formations in the south-eastern zone of the lease area of Free State Saaiplaas Gold Mining is somewhat steeper than originally expected or that reef formations have been upcast by faulting in a section. Instead of sinking the two shafts to depths of 6,000-6,400 ft. No. 1 Shaft, which should intersect the Basal Reef at about 5,375 ft. about the mid-year, will be sunk to 5,700 ft. and No. 2, which should intersect the Basal Reef about next January at about 5,750 ft., will be sunk to about 6,480 ft. Water occurrences in the lease area are not expected to be abnormal ; since measurements were started in boreholes results have shown a persistent lowering of the water-table in the area.

Harmony Gold Mining has negotiated a contract to supply the United Kingdom Atomic Energy Authority with 1,500 tons of uranium oxide over the 1958–1966 period, roughly equivalent to about 47 tons a quarter or slightly less, depending on the date of the start of the new contract. The company states that the new contract can be supplied without further additions to the uranium plant. The existing capacity is thought to be 150,000 tons a month of solids. The improved grade of ore indicated in the new No. 2 Shaft area is expected to yield the additional output of uranium oxide required.

Virginia (O.F.S.) Gold Mining expects to complete the deepening and equipping of the No. 2 Shaft, including the erection of a permanent reinforced-concrete headgear and the installation of a hoist, sometime after the middle of the year. Thereafter underground operations will be extended eastwards into shallower levels from workings which so far have been confined to the western section between what has been the main hoisting shaft, No. 1, and the common boundary with the Harmony mine further to the west. To treat the greater tonnage that will become available the gold plant has been extended to 130,000 tons capacity a month and this may be extended further.

South-West Africa.—Including the recovery from prospecting Consolidated Diamond Mines of South-West Africa in 1957 improved its aggregate yield to 979,544 from 969,984 metric carats ; gravels mined, transported, and screened increased to 3,165,147 cu. metres from 2,800,020 and in all 12,982,843 cu. metres were handled in stripping, mining, and prospecting against 13,817,858 in the previous year, respectively representing 13·25 and 14·24 cu. metres per carat recovered. The overall cost per carat was respectively 82s. 4d. and 68s. 10d.

Additional expenditure on replacing equipment and modifying screening plants in 1957 accounted for the increase in costs, as well the lower average grade and an abnormally large increase in stores being delivered or in transit at the year-end. Capital expenditure declined to £654,226 from £744,670, of which about two-thirds were on machinery and plant. One screening plant was transferred and rebuilt in another area, replacing an obsolete plant there ; another was modernized and in a third area a new field crushing and screening plant was being erected, specifically designed to handle hard conglomerates and cemented gravels peculiar to the area. With the completion of the coastal railway track all gravels from the field plants are now being more rapidly transported to the central main treatment plant where a 60-in. secondary H.M.S. cone has replaced the 48-in. unit, which was found to be too small. The use of spherical ferro-silicon has resulted in a further reduction in the proportion of the sink fraction and the new grease-belt recovery section has been designed accordingly—namely, to handle the smaller tonnage.

Central African Federation.—Rhodesia Broken Hill Development has nearly completed the installation of a heavy-media separation plant. The blast-furnace section of the lead plant satisfactorily produced most of the lead in 1957, but sintering reduced output below expected levels and operating costs were higher than optimum. With the lead price easing it was consequently decided to re-start the Newnham-hearth plant.

Trade Notes

Brief descriptions of developments of interest to the mining engineer

New Tunnel Drill

At a demonstration recently staged in a Derbyshire quarry the **Consolidated Pneumatic Tool Co., Ltd.,** introduced a new 50-lb. machine—the " Tornado " No. 503 tunnel drill, claimed to be capable of extremely fast performance. The quarry, at Breedon-on-the-Hill, was made available by the owners, Breedon and Cloud Hill Lime Works, Ltd. The Tornado—an entirely new British machine, it is stated—was designed to obtain a high power-weight ratio, which has been achieved by the use of a short stroke coupled with a large-diameter piston. This means that the maximum area is exposed to the air pressure in the cylinder and the mass of the piston ensures that high acceleration is obtained with good energy transfer. Air-flow passages through the valve are arranged to minimize pressure drop, while the valve-case cover is shaped to provide immediate acceleration of the piston and good air cushioning at the end of the upstroke. The position of the valve-trigger ports in the cylinder are also arranged so that " freezing " conditions will not affect the action of the machine. At the same time an easy quick-to-operate three-position valve is fitted in the backhead of the machine which allows the

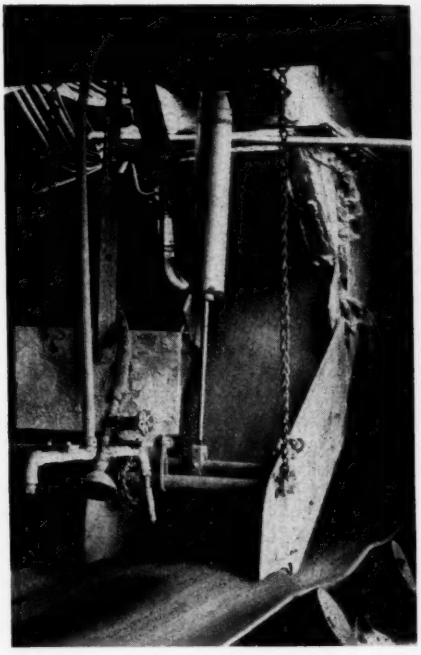
selection of water and emergency blowing air, the third being an off position.

The machine which is illustrated here drilling both wet and dry, in the second case with a Hemborn dust extractor, incorporates a patented retainer designed round a bonded rubber ring which makes assembly and operation simple and provides an excellent cushion in the event of the steel collar striking the retainer.

The complete specification of the "Tornado" No. 503 drill is as follows: Piston diameter, 3 in.; length of stroke, $1\frac{7}{8}$ in.; overall length, $24\frac{3}{4}$ in.; weight, $49\frac{1}{4}$ lb.; air-hose inlet, $\frac{3}{4}$ in.; standard chuck and retainer, $\frac{7}{8}$ in. hex. by $4\frac{1}{4}$ in.; optional chuck and retainer, 1 in. hex. by $4\frac{1}{4}$ in. At 90-lb. air pressure the machine strikes 2,900 blows/min. and consumes 165 cu. ft. of air per min.

Automatic Control Equipment

We were recently afforded an opportunity of seeing a new film produced for **Holman Bros., Ltd.,** which describes some of the many applications of Maxam pneumatic and associated equipment—a name that has for several years been used by the Climax Rock Drill and Engineering Works, Ltd., for these particular products. The film starts by dealing simply with the manufacture and assembly of Maxam valves, cylinders, and solenoids and shows demonstration layouts of this equipment at work. Several of the many



applications of Maxam equipment are also demonstrated to emphasize the versatility and flexibility of the system. As a case in point there is the cylinder-operated remote-control hopper door which forms part of a Maxam-designed installation at a roadstone quarry. The flow of crushed stone through the hopper to a conveyor-belt is controlled by a 3-in. double-acting cylinder which opens or closes the door as required (see illustration), several such doors being so controlled by pilot valves mounted in a panel situated 100 ft. away in the charge of one man. An accuracy of stone chipping mixtures to within 1 to $1\frac{1}{2}\%$ is achieved.

Rectifiers for Industrial Drives

A demonstration of rectifiers for large industrial drives was recently staged as part of a symposium by the **English Electric Co.,** at their works at Stafford. Although it was as long ago as 1932 that this company demonstrated the use of mercury-arc converters for reversing drives, processes of evolution and development have brought the multi-anode pumpless rectifier, the single-anode rectifier (either of the ignitron or excitron

type), and now the single-crystal semiconductor rectifier (germanium or silicon) into industrial use. However, the semiconductor rectifier is at present restricted to the diode form and as such does not provide the control facilities required for reversing drives although it has a significant part to play in connexion with large industrial drives as a source of auxiliary power, by reason of its very high efficiency and compactness.

For the purposes of this note it can be said that the principal applications in which the mercury-arc converter can, at present, be employed for reversing duty are steel mills and mine winders. In the former application it has long been common practice to employ d.c. mill motors fed from motor-generator sets, sometimes driven by synchronous motors, but more often by induction motors, frequently using a flywheel to smooth out the heavy load peaks, while mine winders commonly employ either a.c. motor or d.c. motor drive. The a.c. motor is low in capital cost but at reduced speed it is less efficient that the d.c. motor. As compared with an a.c. system of adequate capacity the mercury-arc converter in general shows the following advantages over the M.G. set, either for rolling mill or d.c. winder duty. It is : (1) Lower in first cost ; (2) less expensive in foundation and installation costs ; (3) more efficient over the normal working range of load ; (4) lower in light load losses ; (5) lower in maintenance cost, and (6) the converter does not add to the fault level of the a.c. system. Compared with an a.c. mine winder the d.c. motor drive fed from a mercury-arc converter is the more expensive in first cost. Its losses, however, are usually less and it permits, of course, the utilization of characteristics of the d.c. motor for economic speed control comparable with those offered by the Ward-Leonard system. With underground winders space considerations and facilities for heat dissipation are of prime importance and in these circumstances the mercury-arc convertor often shows to advantage.

The company suggests that, while it may be dangerous to generalize too broadly, it can be said by way of summary that there is a strong case for the consideration of mercury-arc converters for reversing steel mill duty, both on technical and economic grounds. For mine winders and other applications the diverse nature of the possible load cycles, the requirements for control, and other allied factors demand that each case be considered on its own merits.

Personal

A. L. Austen is here from the Central African Federation.

A. C. M. Cornish Bowden, chairman of Cape Asbestos, has been re-elected president of the Exporters Association of South Africa and T. E. Knight, of Rand Carbide, a vice-president.

W. Brown, H.M. Divisional Inspector of Mines and Quarries, Durham Division, has been appointed H.M. Deputy Chief Inspector of Mines and Quarries.

C. J. Burns has been co-opted to the board of Bremang Gold Dredging, Ltd.

J. E. Denyer has resigned from Cyanamid of Great Britain, Ltd., on his appointment as a director of the Britannia Lead Co., Ltd., and the Siamese Tin Syndicate, Ltd.

A. S. Humphrys, manager of the Australian office of Humphreys and Glasgow, Ltd., is here from Sydney.

H. Hyde, H.M. Divisional Inspector of Mines and Quarries, Northumberland and Cumberland Division, has been appointed Divisional Inspector, Scottish Division.

E. H. Jacques is returning from Ghana.

D. G. Norris is leaving for Mexico.

G. B. O'Malley has been awarded the Institute Medal by the Australasian Institute of Mining and Metallurgy.

T. I. Piner is now in Thailand.

G. A. Schnellmann, of MacKay and Schnellmann, mining consultants to Paringa Mining and Exploration, recently visited Australia to examine that company's Milo Leases in the Cloncurry district of Queensland.

F. M. Vokes is returning from Canada.

Peter Westerberg is home from Rhodesia and East Africa.

W. Widdas, H.M. Divisional Inspector of Mines and Quarries, Scottish Division, has been appointed Divisional Inspector of the Durham Division.

H. F. Wilson, H.M. Senior District Inspector of Mines and Quarries, West Midland and Southern Division, has been appointed Divisional Inspector, Northumberland and Cumberland Division.

T. H. Winsor has left for Burma.

George Alfred Sydney Harvey, president of G. A. Harvey and Company (London), Ltd., died on May 28, aged 73. Mr. Harvey, who entered his father's business, was appointed assistant managing director on the incorporation of the company in 1913 when the works were moved to its present site in Woolwich Road, becoming chairman and managing director on the death of his father.

A. H. Waine, a director of Hadfields, Ltd., and managing director of the subsidiary company, Hadfields Forgings, Ltd., died on May 4, aged 57. Mr. Waine studied at Sheffield University where he gained the Associateship in Metallurgy and the Associateship in Engineering, being awarded the Mappin Medal in 1930. In 1945, when manager of the heat treatment departments at both Hecla and East Hecla Works, he became a local director of Hadfields, Ltd., later joining the board of Hadfields Foundry and Engineering and acting as the technical manager. Mr. Waine was a Fellow of the Institution of Metallurgists, an Associate of the Institution of Mechanical Engineers, a member of the Iron and Steel Institute, and a member of the Sheffield Society of Engineers and Metallurgists.

Metal Markets

During May [1]

Copper.—There have been several new developments of interest in copper in the past month, but on the whole it has been mainly a featureless period and there has certainly been an absence of fireworks as far as prices are concerned.[2] Developments affecting the producing side of the industry have more or less balanced out from the point of view of sentiment as the strike at Chuquicamata was settled about the middle of the month. However, a further important output cut was announced by Phelps Dodge, followed by a similar though less extensive move by Anaconda at its American mines. On the consuming side, which remains, of course, the source of the industry's weakness, there is little new to report.

Political events have, perforce, had to figure largely in the market's consciousness during May. Of general significance has been the French political crisis, the only immediate impact of which on the copper market was the stopping of import licences at the end of the month. In the U.S.A. further details have been released of the proposed minerals subsidy programme, to which reference was made last month. The chief advance since that initial comment has been the provision of maximum subsidies payable, which has meant effectively that floor prices have been established—a provision which most intelligent observers were quick to point out was necessary if cut-throat competition down to impossible levels was to be avoided. With a stabilization price of 27½ cents and a maximum subsidy of 3⅛ cents per lb. the U.S. internal copper price should be guaranteed at a floor of 24 cents, although this is small consolation to the primary producers struggling hard to hold their selling price at 25 cents. It is worth noting that in defence of this price level two U.S. producers have announced further cuts in the past month.

In the U.K: the unsatisfactory labour situation in the motor, transport, and dock fields has kept the market slightly nervous, but the Bank Rate cut to 5½% helped to offset this. A bear factor worth noting is that Australian producers are to receive additional tariff protection as well as a bounty to stabilize the price at £A330 per ton.

Consumption of copper in the U.K. in March at 53,071 tons (41,539 tons refined) brought the first quarter's total to 161,245 tons, 8,000 tons less than in the same period of 1957. Production was 8,535 tons primary refined and 6,408 tons secondary refined. A small drop in blister copper stocks did not offset a rise in refined copper stocks from 69,286 tons to 75,410 tons.

Tin.—The main feature of interest in the tin market in May was the announcement of the decisions reached at the meeting of the International Tin Council at the end of April. As far as the market was concerned the most important news was that export controls at existing levels are to be maintained for the third quarter of the year. The regular re-allocation of producer votes was also effected; to some extent and especially in certain directions this procedure gave rise to a fresh bout of doubts about the ability of the Agreement to endure. The doubts were engendered, as observers have come to expect, in the minds of U.S. tin dealers and were brought about by Thai talk of withdrawing from the Agreement because the quotas in that country (which are related to the voting power) had not been increased by 10%. More recently more reasonable counsels seem to have prevailed and in any case the general trend of opinion is increasingly that the Agreement will ultimately succeed in reversing the statistical position of tin and improving the price.

U.K. March consumption was 1,566 tons, making the quarter only 4,866 tons, against 5,948 tons in the preceding period of 1957. Production figures are not available.

Lead.—The U.S. Government's minerals stabilization proposals have been an important talking point in the lead market in May. The stabilization level proposed is 14¾ cents per lb. and the maximum subsidy would be 3⅜ cents, making an effective floor level of 11⅜ cents; the current market price, of course, is 11½ cents. Apart from this topic the market has been a pretty featureless one in the month,[1] showing only a brief flash of life on the occasion of the reduction in the U.K. Bank Rate. The strike at the works of the Pressed Steel Co. with its attendant interruption to motor-car output had a small effect on battery demand. A new development of which more may be heard in the future was the offering of some small quantities of Chinese lead.

U.K. consumption in March was 29,713 tons, bringing the quarter's consumption very nearly up to the total for the same period of the year before. Production was 7,448 tons and stocks were well down at 40,547 tons.

Zinc.—Under the proposed U.S. minerals stabilization programme the price for zinc would be 12¾ cents and the maximum subsidy 2½ cents, giving an effective floor level of 10¼ cents against the current 10 cents. The zinc market[1] has, however, remained as apparently apathetic to this item of information as to most of the others in recent months. All the metals are beginning to wear the appearance of men waiting for some major event to work itself out (the major event, of course, being a recovery in global and, particularly, American demand). In none, however, is it so marked as in zinc. This may be partly due to the fact that the level of prices is just that bit lower down the scale and margins of £1 a ton or so are thus proportionately less likely. Chiefly, however, the inertness of prices is due to the greater weight of statistical bear news depressing the market.

U.K. March zinc consumption was 26,967 tons, bringing the quarter's total to within 2,500 tons of the previous comparable period's performance—an indirect reflection of the extent of the adverse U.S. statistical situation. Production was 6,831 tons and stocks were virtually unchanged at 46,608 tons.

Iron and Steel.—The U.K. steel industry is experiencing considerable changes in the general pattern of demand. Higher outputs coupled with a decline in demand for a number of products has resulted in an easier supply position and consumers are now able to obtain steel at much shorter notice. This is a notable difference compared with conditions since the end of the war, when consumers were compelled to carry large stocks because of the general shortage. Stocks over the past few years have been built up to immense proportions and

[1] Recent prices, pp. 328, 368.
[2] See Table, p. 368.

[1] See Table, p. 368.

recently estimated to equal about 5,000,000 ingot tons. With increased output there is now no compelling need to hold large reserves; the Government's financial policy has also made this less attractive and during the period of stock adjustment which is now taking place quieter conditions will prevail and the industry will be forced to operate well below capacity.

Production of steel has fallen as a result of reduced demand both from home and abroad and a number of steelmaking and finishing facilities have either been laid idle or are working a shorter number of shifts. Raw steel output in April fell to 407,800 tons a week from 432,300 tons a week in March and 430,000 in April, 1957. Consumption of many products, however, is still very high; the reduced pressure on mills is largely the result of destocking by consumers.

U.K. exports of iron and steel have been affected by a weakening in world markets (where consumers are also running down stocks) and fiercer competition from other exporting countries. Although exports were higher in April than in the previous month, totalling 254,125 tons and 217,260 tons respectively, they declined to 938,714 tons in the first four months of 1958, as compared with 1,085,159 tons in the same period of 1957.

As a result of higher home outputs there is no longer the need for consumers to import large quantities of foreign steel. In April, at 76,282 tons, they were the lowest since January, 1955, and in the January–April period of this year arrivals fell to 340,686 tons, from 425,948 tons in the corresponding period of last year. A large proportion of imports in the first four months of this year, however, comprised sheet steel. This reflects the heavy requirements of the U.K. motor industry whose needs still cannot be completely covered from domestic sources.

Iron Ore.—U.K. imports of iron ore continue at a high rate. In April they totalled 1,046,621 tons, as compared with 1,055,513 tons in March and 1,173,805 tons in April, 1957, while in the first four months of 1958 they reached 4,383,704 tons, from 4,162,058 tons in the corresponding period of 1958. Large stocks of ore have accumulated, while consumption has been affected by some curtailments in pig-iron production. Unlike imports, which have been maintained at a high rate, home output has declined. In the first three months of this year production fell to the weekly average rate of 293,400 tons, as compared with 345,300 tons a week in the same period of 1957.

Aluminium.—The price cuts both in the U.K. and the U.S.A. last month have had little or no effect on consumer buying interest during the past four weeks. Not that a revival was expected with the present generally depressed industrial picture. The aluminium market as a whole seems to be still somewhat overshadowed by offerings of cheap Russian and Eastern Bloc metal and as yet there has been no further news regarding the application for an anti-dumping duty on aluminium from the former source. However, the mere fact that this duty has been applied for should logically tend to discourage consumers from obtaining supplies from Russia, although this has not been the case in all sections of the market. The smaller outlets for aluminium, the main buyers of Russian metal before the anti-dumping application, are still thinking in terms of the lower prices asked by the Russians—down to £165 a ton c.i.f.

Despite the reduction in U.S. prices there is still talk of a possible increase in the aluminium duty there from the present 1·3 cents per lb. to 4 cents a lb. In Germany Aluminium Rheinfelden G.m.b.H. is reported to have asked that the quota of 40,000 tons of aluminium a year which at present may enter Germany duty free be abolished and the 7% duty be re-imposed.

The price of aluminium ingot 99·5% delivered in the U.K. remains at £180 a ton.

Antimony.—During May prices of imported metal continued to ease and about the middle of the month reached about £147, subject to duty, a ton for Chinese 99% material, £148 to £150 for Chinese 99·6%, and for Russian regulus 99·8%, £157 to £158 a ton. Consumer buying interest is almost non-existent, with little indication of any pick-up in the near future. English regulus is still quoted at £197½ per ton delivered.

Arsenic.—May saw no change in this market and metal is still quoted at £400 a ton. Imports into the U.K. during the month of April totalled 220 tons, bringing the total for the first four months of this year to 1,848 tons, an increase over the same period of 1957 of 242 tons.

Bismuth.—The only item of interest which affected this market during May was the action by the U.K. Board of Trade making it unnecessary to obtain licences for the export of bismuth and bismuth alloys. This became effective on May 24.

April imports totalled 101,360 lb.; the price of bismuth remains unaltered at 16s. per lb.

Cobalt.—Although not a market factor it is interesting to note that during the first quarter of this year Chibuluma Mines began the sale of cobalt and in so doing lost some £165,000. This loss, however, was due to the comparatively small amount handled by the company's plant and usual teething troubles. The overall position in this metal remains unaltered, with the price in this country quoted at 16s. per lb.

Imports into the U.K. during April totalled only 9,386 lb., as compared with 484,086 lb. during the previous month.

Cadmium.—A recent interesting development in cadmium is that both producers and consumers are becoming increasingly aware of the potentials of this metal in higher purities than usual. It is understood that both in the U.K. and Japan producers are making metal with a purity over the normal 99·9% on a laboratory scale.

In the U.K. the price of 99·9% metal remains quotable at 10s. per lb.; April imports totalled 134,251 lb.

Chromium.—The past month was another quiet one for this metal with the usual amount of business passing. The price is unaltered and is quoted at 6s. 11d. to 7s. 4d. for 98% to 99% material.

Tantalum.—As was mentioned in the last report the demand for tantalum is quite brisk and during April imports of columbite-tantalite concentrates into the U.K. totalled 88 tons, as compared with only 22 tons in the previous month.

The 60% Ta_2O_5 material in the U.K. is still 900s. to 1,000s. per unit. Nigerian columbite is reckoned at 180s. a unit for royalty purposes.

Platinum.—Once again platinum prices both in this country and the U.S.A. have been reduced. Leading suppliers in the U.S.A. are now quoting a range of $67 to $70 per troy oz., a drop of $5, and in this country platinum is now quoted at £25, compared with the previous £26 15s. per oz. This price reduction occasioned little comment as it

was long expected and served only to deepen the depression already overhanging this market a little more. Once again the quotation for imported material in this country is well below that of the leading suppliers at £22 to £22 10s. with, it is understood, metal offering on the U.S. open market at as low as $63 per troy oz.

Iridium.—Iridium is still nominally quoted at £21 to £24 per troy oz., with business moving at a very slow pace. Imports of platinum-group metals during April totalled 6,579 troy oz.

Osmium.—Like the other members of the platinum metals group osmium has remained sluggish during the past month with the price still nominally quoted at £18 to £20 per troy oz.

Palladium.—After the fall in price in April palladium settled into something of a rut, as was the case with the other metals in this group. The rumours in April of palladium offering from Russian sources at prices under the bottom of the current range in the U.K. have not as yet been substantiated. The U.K. price is unchanged at £5 15s. to £6 5s. per troy oz.

Tellurium.—Once again tellurium has presented no outstanding features during the month, with the price remaining at 15s. to 16s. per lb.

Tungsten.—The tungsten market continued its downward movement during May, with supplies continuing to exceed demand. There are no indications of any revival in demand in the immediate future, particularly with the steelworks' holidays in the not too distant future. Latest market news is that a comparatively large amount of business has been done at as low as 76s. and the current price is quoted at 76s. to 80s. per long ton unit of WO_3.

Nickel.—The nickel position remains one of oversupply despite the recent cuts by the International Nickel Co. of Canada. Although prices on the open market in this country have eased to as low as £500 to £550 a ton there has not been any alteration in the price of the Canadian producer. A sign of the times is that both in America and this country relaxations in duties and export regulations were brought into effect during the month.

The price of nickel in the U.K. continues to be quoted at £600 a ton.

Chromium.—As was surmised in the last report prices of Rhodesian chrome ore have been reduced and metallurgical 48% material is now quoted at £16 5s. a ton c.i.f. This alteration has been expected for some time now owing to the excess of production over consumption. Stocks of ore have been building up at ports and mines in Africa and in order to try to improve the situation the cuts in the contract prices were initiated.

Molybdenum.—This was a fairly quiet market during May and with the current position of supplies exceeding demand looks like continuing to be so for a little while at any rate. Climax production continues to be curtailed in an attempt to alleviate the present oversupply position; the price in the U.K. is quoted at 8s. 5d. per lb. of Mo f.o.b. Climax, Colorado.

Manganese.—Very little of any interest occurred in this market during May and, as has been mentioned before, with the majority of consumers probably already being covered for their 1958 requirements, there is not much likelihood of any startling features emerging in the immediate future. Manganese ore 46% to 48% Mn is still quoted at 102d. to 104d. per unit c.i.f. Europe.

Tin, Copper, Lead, and Zinc Markets

Tin, minimum, 99·75%; Copper, electro; Lead, minimum 99·75%; and Zinc, minimum 98%, per ton.

Date		Tin		Copper		Lead		Zinc	
		Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
		£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
May	12	733 10	737 5	179 17½	181 7½	72 16¼	72 18¾	62 6¼	62 13¼
	13	731 0	733 15	179 10	181 5	72 3¾	72 11¼	61 11¼	61 18¾
	14	730 10	733 5	177 5	179 7½	72 2½	72 11¼	61 3¾	61 16¼
	15	730 10	733 5	176 17½	178 12½	72 5	72 7½	61 6¼	61 18¾
	16	730 10	732 15	177 7½	179 7½	72 3¾	72 7½	61 2½	61 11¼
	19	730 10	733 10	178 2½	180 2½	72 1¼	72 6¼	61 6¼	61 13¾
	20	731 0	734 10	176 17½	178 17½	72 1¼	72 6¼	61 8¾	61 16¼
	21	730 10	733 15	177 12½	179 15	71 18¾	72 6¼	61 8¾	61 16¼
	22	730 10	733 5	178 12½	180 17½	71 16½	72 6¼	61 11¼	62 1¼
	23	730 10	733 5	179 5	181 17½	71 16¼	72 6¼	61 6¼	61 18¾
	26	730 10	732 15	180 2½	182 7½	71 6¼	72 2½	61 3¾	61 16¼
	27	730 10	732 15	180 2½	182 7½	71 6¼	72 2½	61 3¾	61 16¼
	28	730 10	733 5	181 12½	183 17½	71 2½	71 18¾	61 8¾	61 18¾
	29	730 10	733 5	181 10	183 17½	70 17½	71 13¾	61 11¼	62 1¼
	30	730 10	733 5	179 7½	182 10	70 11¼	71 11¼	61 18¾	62 6¼
June	2	730 10	732 15	181 12½	184 7½	71 7½	71 17½	61 17½	62 7½
	3	730 10	733 5	183 7½	186 7½	71 15	72 2½	62 15	63 2½
	4	730 10	733 5	184 7½	187 7½	71 11¼	72 1¼	63 2¼	63 7½
	5	730 10	734 15	183 7½	185 17½	71 11¼	71 18¾	62 13¾	62 17½
	6	730 10	734 15	184 17½	187 10	71 11¼	71 12½	62 8¾	62 15
	9	730 10	735 5	187 5	189 7½	70 17½	71 7½	62 3¾	62 12½
	10	730 10	734 15	189 12½	192 7½	70 13¾	71 7½	62 7½	62 18¾
	11	730 10	734 15	198 0	200 5	71 6¼	72 1¼	62 18¾	63 13¾

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	April		May	
	Treated Tons.	Yield Oz.*	Treated Tons.	Yield Oz.†
Blyvooruitzicht	105,000	61,646	112,000	64,485
Brakpan	126,000	16,706	129,000	16,634
Buffelsfontein‡	114,000	38,025	117,000	39,081
City Deep	138,000	26,054	148,000	28,250
Cons. Main Reef	135,000	21,476	142,000	21,894
Crown Mines	223,000	34,204	238,000	36,130
Daggafontein	232,000	48,418	238,000	49,261
Doornfontein‡	87,000	36,240	88,000	36,630
D'rb'n Roodeport Deep	173,000	31,562	187,000	33,832
East Champ D'Or‡	12,000	303	12,500	345
East Daggafontein	91,500	15,212	92,000	15,281
East Geduld	125,000	38,438	135,000	41,525
East Rand P.M.	212,000	55,096	230,000	58,705
Eastern Transvaal Consol	18,400	6,347	18,700	6,610
Ellaton‡	33,000	7,700	32,000	7,467
Freddies Consol.	51,000	15,781	55,000	14,423
Free State Geduld	67,500	48,501	68,500	49,112
Geduld	80,000	12,569	83,000	13,086
Government G.M. Areas‡	62,000	10,169	64,500	11,052
Grootvlei Proprietary	195,000	41,547	205,000	43,571
Harmony Gold Mining	74,000	29,855	78,000	30,826
Hartebeestfontein‡	84,000	46,200	85,000	46,750
Libanon	100,000	22,990	100,000	22,972
Loraine	70,000	12,896	72,000	13,266
Luipaards Vlei‡	120,000	14,179	120,000	13,904
Marievale Consolidated	69,000	18,142	74,000	19,348
Merriespruit‡	—	—	—	—
Modderfontein East	135,000	12,913	148,000	13,779
New Kleinfontein	92,000	9,924	88,000	10,353
New Klerksdorp‡	10,400	1,129	10,400	1,170
President Brand	85,000	62,920	87,500	65,843
President Steyn	97,000	37,065	98,000	37,423
Rand Leases	165,000	24,915	174,000	25,665
Randfontein‡	181,000	14,624	194,000	15,806
Rietfontein Consolid't'd.	21,500	4,987	21,500	4,987
Robinson Deep	73,000	15,640	72,000	15,473
Rose Deep	56,000	7,635	60,000	7,273
St. Helena Gold Mines	116,000	33,755	119,000	34,941
Simmer and Jack	91,000	17,043	88,000	16,687
S. African Land and Ex.	90,000	18,240	91,000	18,473
S. Roodepoort M.R.	28,000	6,770	30,000	7,121
Spaarwater Gold	10,700	3,295	10,700	3,294
Springs	128,000	14,192	127,000	14,074
Stilfontein Gold Mining‡	110,000	54,653	112,000	55,496
Sub Nigel	66,500	16,376	66,500	16,070
Transvaal G.M. Estates	16,700	2,530	—	—
Vaal Reefs‡	69,500	31,276	72,000	32,400
Van Dyk Consolidated	74,000	13,898	78,000	14,991
Ventersp ost Gold	125,000	29,681	127,000	30,004
Village Main Reef	30,000	4,802	29,000	4,495
Virginia O.F.S.‡	101,000	26,521	101,000	26,422
Vlakfontein	50,000	17,600	50,000	17,613
Vogelstruisbult‡	95,000	21,204	96,000	21,274
Welkom Gold Mining	87,500	25,960	87,500	26,082
West Driefontein‡	77,000	73,929	77,500	74,227
West Rand Consol. ‡	208,000	20,946	209,000	21,358
Western Holdings	97,000	53,968	98,000	54,739
Western Reefs	114,500	26,908	114,500	26,909
Witwatersrand Nigel	17,600	4,349	17,600	4,352

† 248s. 4d. * 248s. 8d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Mar., 1957.	16,430,800	60 8	44 8	16 0	20,657,462
April	—	—	—	—	—
May	—	—	—	—	—
June*	16,785,200	62 4	45 1	17 3	22,595,371
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,699,900	64 0	45 6	17 3	24,193,575
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	16,198,500	64 4	46 1	18 3	23,695,380
Jan., 1958.	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	15,806,300	64 10	46 6	18 4	23,170,987

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
May, 1957	1,361,688	45,361	1,450,668
June	1,405,307	24,957	1,420,021
July	1,395,064	53,099	1,479,439
August	1,426,340	38,941	1,459,794
September	1,400,745	37,611	1,438,356
October	1,416,211	39,996	1,456,207
November	1,386,047	36,470	1,422,517
December	1,366,354	35,789	1,402,143
January, 1958	1,377,505	40,534	1,418,039
February	1,322,843	33,879	1,356,722
March	1,394,956	36,330	1,431,286
April	1,401,094	38,352	1,439,446

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
August 31, 1957	322,847	28,604	351,451
September 30	315,955	28,170	344,125
October 31	310,428	28,020	338,448
November 30	305,104	27,619	332,723
December 31	299,137	27,623	326,760
January 31, 1958	314,239	28,489	342,728
February 28	326,885	30,227	357,112
March, 31	333,862	31,203	365,065
April, 30	337,284	31,424	368,708

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To May 3		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	21,870	3,391	4,518
Electrolytic Zinc	17,218	947	5,322
Lake George	18,077	1,371	2,670
Mount Isa Mines**	69,085	5,655†	2,761
New Broken Hill	39,280	5,349	8,656
North Broken Hill	27,189	5,443	5,416
Zinc Corp.	46,260	7,739	8,240
Rhodesia Broken Hill*	—	—	—

* 3 Mths. ** Copper 3,075 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	April		May	
	Tons	Oz.	Tons	Oz.
Cam and Motor	31,724	9,988	30,939	9,767
Falcon Mines	22,615	4,170	210750	4,261
Globe and Phœnix	5,900	3,238	6,200	3,586
Motapa Gold Mining	14,800	2,010	15,700	1,944
Mazoe	3,139	956	3,025	861
Coronation Syndicate	11,890	2,442	11,447	2,310
Phoenix Prince*	—	—	—	—

* 3 Months

WEST AFRICAN GOLD OUTPUTS

	April		May	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	60,197	13,973	60,062	13,811
Ariston Gold Mines	40,000	12,709	37,500	11,937
Ashanti Goldfields	30,000	22,500	31,250	22,750
Bibiani	35,000	6,900	35,000	6,900
Bremang	—	3,664	—	4,187
Ghana Main Reef	11,500	4,014	11,371	4,263
Konongo	5,790	3,900	5,820	3,950
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1957		1958	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,337	6,134	44,305	46,553
February	41,607	5,697	43,591	21,313
March	43,831	8,179	43,830	8,179
April	46,754	6,854	46,587	22,573
May	42,650	5,606	—	—
June	46,682	6,441	—	—
July	41,922	5,781	—	—
August	44,001	5,897	—	—
September	45,762	5,677	—	—
October	46,838	5,570	—	—
November	46,987	6,331	—	—
December	45,479	5,814	—	—

WESTRALIAN GOLD PRODUCTION

	1956	1957	1958
	Oz.	Oz.	Oz.
January	66,388	106,722	66,562
February	94,638	64,949	65,965
March	66,944	67,121	65,420
April	60,415	66,435	60,855
May	62,294	64,886	—
June	63,570	65,142	—
July	69,883	74,420	—
August	72,303	75,727	—
September	62,204	64,422	—
October	64,594	64,524	—
November	64,113	65,700	—
December	65,031	66,562	—
Total	812,377	846,610	842,004

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Apr. 15		To May 13	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,223	7,153	14,143	7,609
Crœsus Proprietary	—	—	—	—
Gold Mines of Kalgoorlie	38,994	9,899	38,117	9,613
Golden Horse Shoe*	—	—	—	—
Gt. Boulder Gold Mines*	—	—	114,823	27,667
Gt. Western Consolidated	36,647	5,703	32,297	5,984
Hill 50	9,654	5,504	9,879	5,629
Kalgurli Ore Treatment	—	—	—	—
Lake View and Star*	—	—	—	—
Moonlight Wiluna*	—	—	—	—
Morning Star (G.M.A.)	—	—	956	406
Mount Ida	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgurli	27,286	5,605	—	—
Sons of Gwalia	11,590	1,896	11,650	2,280
Mount Morgan	—	3,930	—	3,580

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
December, 1956	741,525	213,846	60,129	7,180,865
Jan., 1957	759,681	210,404	33,082	7,114,391
February	702,636	197,225	32,199	6,635,527
March	793,674	215,830	35,787	7,250,018
April	771,608	216,457	35,685	7,314,450
May	790,159	222,436	37,241	7,509,638
June	738,384	207,897	32,544	6,945,127
July	718,468	198,620	30,620	6,572,323
August	701.174	192,453	31,647	6,410,429
September	722,384	205,471	34,248	6,947,813
October	772,383	224,217	37,086	7,657,426
November	756,494	219,352	37,737	7,441,702
December	750,537	215,462	44,230	7,494,289
January, 1958	779,128	219,502	31,562	7,462,598
February	727,170	210,646	35,370	7,248,333
March	807,458	229,361	38,323	7,873,264

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	Apr.		May	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	1,009	—	1,107
Central Victoria Dredging	—	—	—	—
Clutha River	—	307	—	337
Emperor Mines (Fiji)*	—	—	46,315	17,906
Frontino Gold (Colombia)	—	—	—	—
Geita Gold (Tanganyika)	26,640	3,338	—	—
Harrietville (Aust.)	—	—	—	—
Lampa (Peru)†	—	36,225	—	37,948
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	3,466	824	—	—
St. John d'el Rey (Brazil)	—	—	—	—
Yukon Consol.	—	—	—	—

* 3 Months. † Ozs. Silver: 61 tons copper, 61 tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Mar.	Apr.	May
Ampat Tin	68½	76½	—
Austral Amalgamated	—	—	—
Ayer Hitam	188*	—	—
Batu Selangor	—	—	—
Berjuntai	178½	176	—
Chenderiang	27*	—	—
Gopeng Consolidated	118*	—	—
Hongkong Tin	64½*	—	—
Idris Hydraulic	19½*	—	—
Ipoh	68*	—	—
Jelapang Tin	—	—	—
Kampong Lanjut	69	80	—
Kamunting	82½	104	—
Kent (F.M.S.)	50*	—	—
Kepong	58*	—	—
Killinghall	63½*	—	—
Kinta Kellas	—	—	—
Kinta Tin Mines	73*	—	—
Klang River	—	—	—
Kramat	45	30	—
Kuala Kampar	100	85½	—
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	37	30	—
Lower Perak	149	130½	—
Malayan	377*	—	—
Malaysiam	—	7	4½
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	191	—	—
Pengkalen	72*	—	—
Petaling Tin	247*	—	—
Puket	45*	—	—
Rahman Hydraulic	—	—	—
Rambutan	27½*	—	—
Rantau	65	72½	—
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	—	—	—
Selayang	50*	—	—
Siamese Tin Syndicate (Malaya)	—	15	—
Southern Kinta	353	340	—
Southern Malayan	586*	—	—
Southern Tronoh	138*	—	—
Sungei Besi	204*	—	—
Sungei Kinta	48*	—	—
Sungei Way	266*	—	—
Taiping Consolidated	41	47½	—
Tambah	—	—	—
Tanjong	163*	—	—
Tekka	24*	—	—
Tekka-Taiping	—	31	—
Temoh	19*	—	—
Tongkah Compound	—	—	—
Tongkah Harbour	—	51	—
Tronoh	463*	—	—
Ulu Klang	—	—	—

* 3 months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	Apr.		May.	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	200	—	—	—
Anglo-Burma Tin	31	—	—	—
Bangrin	48	—	—	—
Beralt	55	90†	58	105†
Bisichi	39½	5	52	6
Ex-Lands Nigeria	30	—	40	—
Geevor	56	—	60	—
Gold and Base Metal	29	—	41	—
Jantar Nigeria	15	8½	15½	16½
Jos Tin	12	—	—	—
Kaduna Prospectors	6	—	5	—
Kaduna Syndicate.....	21½	—	16	—
Katu Tin.....	39	—	—	—
Keffi Tin	—	—	—	—
London Nigerian Mines ...	—	—	—	—
Mawchi Mines	—	52‡	—	66‡
Naraguta Extended	8	—	11	—
Naraguta Karama	11	—	11	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria) ...	3½	—	—	—
Siamese Tin Syndicate	35	—	—	—
South Bukeru.....	—	—	—	—
South Crofty	62½	—	65	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria.....	1	—	—	—
United Tin Areas of Nigeria	4	—	—	—

† Wolfram. ‡ Mixed Concs.

SOUTH AFRICAN MINERAL OUTPUT

March, 1958

Gold.....	1,430,322 oz.
Silver	140,791 oz.
Diamonds	80,316 carats.*
Coal	3,370,262 tons.
Copper.....	(*a*) 101 tons in matte and copper-gold concentrates. (*b*) 4,760 tons of 99·47%.
Tin	231 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	16,495 tons.
Chrome Ore	59,085 tons.
Manganese Ore	63,396 tons.
Lead Concs.....	— tons.

*Feb., 1958.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		Mar.	Apr.
Iron Ore	tons	1,055,513	1,046,612
Manganese Ore.....	,,	62,817	25,803
Iron and Steel	,,	90,134	76,282
Iron Pyrites	,,	11,941	15,304
Copper Metal	,,	20,037	36,183
Tin Ore	,,	2,608	6,476
Tin Metal	,,	1,018	582
Lead.....	,,	7,710	9,508
Zinc Ore and Conc.	,,	14,754	3,775
Zinc	,,	11,993	11,464
Tungsten Ores	,,	326	822
Chrome Ore	,,	24,885	11,921
Bauxite	,,	36,931	25,298
Antimony Ore and Concs.....	,,	1,360	333
Titanium Ore	,,	20,244	31,617
Nickel Ore	,,	3,327	2,821
Tantalite/Columbite	,,	22	88
Sulphur	,,	36,388	14,210
Barytes	,,	2,642	6,168
Asbestos	,,	10,068	10,818
Magnesite	,,	5,159	1,107
Mica	,,	567	313
Graphite	,,	642	730
Mineral Phosphates	,,	89,722	78,812
Molybdenum Ore	,,	587	298
Nickel	cwt.	20,037	35,189
Aluminium	,,	218,488	174,690
Mercury.....	lb.	331,931	102,651
Bismuth	,,	132,000	101,360
Cadmium	,,	205,168	134,251
Cobalt and Cobalt Alloys	,,	484,068	9,386
Selenium	,,	26,981	6,987
Petroleum Motor Spirit ...1,000 gals.		56,278	51,824
Crude	,,	650,639	760,372

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
,, ,, 80% Technical	,,	97	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate.....	,,	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
,, Chloride, 98%	,,	26	0	0
,, Phosphate (Mono- and Di-) ...	,,	102	0	0
Antimony Sulphide, golden	per lb.		3	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94%	,,	Nominal		
,, Chloride	,,	53	0	0
Barytes (Bleached)	,,	20	0	0
Benzole	per gal.		5	2
Bleaching Powder, 36% Cl.	per ton	30	7	6
Borax	,,	44	0	0
Boric Acid, Comml.	,,	75	10	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	13	5	0
Carbolic Acid, crude 60's	per gal.		8	3
Carbon Bisulphide.....	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	2¾
Citric Acid	per cwt.	11	0	0
Copper Sulphate	per ton	66	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, 97–98%	,,		6	6
Hydrochloric Acid 28° Tw.	per carboy		13	0
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate.....	per ton	3	17	6
Lead, Acetate, white	,,	124	0	0
,, Nitrate	,,	116	0	0
,, Oxide, Litharge	,,	106	5	0
,, Red.....	,,	104	5	0
,, White	,,	115	10	0
Lime, Acetate, brown	,,	40	0	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	9	0	0
Magnesium Chloride, ex W'h'se	,,	16	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.....	per gal.		6	3
Nitric Acid, 80° Tw.....	per ton	37	10	0
Oxalic Acid	,,	129	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Pine Oil.....	per ton	Nominal		
Potassium Bichromate	per lb.		1	2½
,, Carbonate (hydrated)	per ton	74	10	0
,, Chloride, 96%	,,	21	0	0
,, Iodide	per lb.		9	0
,, Amyl Xanthate	,,	Nominal		
,, Ethyl Xanthate.....	,,	Nominal		
,, Hydrate (Caustic) solid	per ton	118	0	0
,, Nitrate	per cwt.	4	1	0
,, Permanganate	per ton	193	10	0
,, Sulphate, 48%	,,	22	1	0
Sodium Acetate	,,	99	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	15	0	0
,, Bichromate	per lb.		1	0
,, Carbonate (crystals)	per ton	Nominal		
,, ,, (Soda Ash) 58%	,,	13	5	0
,, Chlorate	,,	92	0	0
,, Cyanide 100% NcAN basis	per cwt.	6	6	6
,, Hydrate, 76/77%, solid	per ton	33	0	0
,, Hyposulphite, Comml.	,,	32	15	0
,, Nitrate, Comml.	,,	29	10	0
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate.....	per lb.		1	0½
,, Silicate	per ton	11	0	0
,, Sulphate (Glauber's Salt).....	,,	9	15	0
,, ,, (Salt-Cake).....	,,	8	0	0
,, Sulphide, flakes, 60/62%	,,	37	2	6
,, Sulphite, Comml.	,,	27	10	0
Sulphur, American, Rock (Truckload).....	,,	17	0	0
,, Ground, Crude	,,	19	0	0
Sulphuric Acid, 168° Tw.	,,	10	15	0
,, ,, free from Arsenic, 140° Tw.	,,	8	3	0
Superphosphate of Lime, 18% P_2O_5	,,	14	18	6
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	104	0	0
,, Oxide	,,	86	10	0
,, Sulphate	,,	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	May 6, 1958 £ s. d.	June 9, 1958 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	1 18 0	2 3 3
Blyvooruitzicht (2s. 6d.)	1 1 0	1 2 3
Brakpan (5s.)	4 6	5 6
Buffelsfontein (10s.)	1 16 9	1 17 9
City Deep	15 3	14 6
Consolidated Main Reef	17 3	16 3
Crown Mines (10s.)	1 6 3	1 4 6
Daggafontein (5s.)	1 9 3	1 9 3
Dominion Reefs (Ord. 5s.)	12 9	12 6
Doornfontein (10s.)	1 4 0	1 7 0
Durban Roodepoort Deep (10s.)	1 8 3	1 8 9
East Champ d'Or (2s. 6d.)	1 9	2 0
East Daggafontein (10s.)	8 6	8 6
East Geduld (4s.)	1 4 0	1 5 6
East Rand Proprietary (10s.)	2 2 0	2 1 6
Freddies Consol.	2 3	2 6
Free State Dev. (5s.)	4 0	4 0
Free State Geduld (5s.)	3 18 0	4 3 9
Free State Saaiplaas (10s.)	11 0	11 3
Geduld	3 0 0	3 4 9
Government Gold Mining Areas (5s.)	4 0	4 0
Grootvlei (5s.)	15 6	15 9
Harmony (5s.)	1 12 9	1 15 6
Hartebeestfontein (10s.)	2 17 6	3 3 0
Libanon (10s.)	7 6	8 3
Loraine (10s.)	1 9	2 3
Luipaards Vlei (2s.)	10 3	10 3
Marievale (10s.)	18 3	18 9
Merriespruit (5s.)	4 0	4 0
Modderfontein B (3d.)	3 0	2 9
Modderfontein East	14 0	15 0
New Kleinfontein	5 0	4 9
New Pioneer (5s.)	1 9 3	1 14 0
New State Areas (16s.)	2 3	2 0
President Brand (5s.)	2 7 3	2 11 6
President Steyn (5s.)	1 5 9	1 6 3
Rand Leases (10s.)	4 0	4 6
Randfontein	1 4 0	1 4 3
Riebeeck (10s.)	9 0	13 0
Rietfontein (5s.)	8 6	8 9
Robinson Deep (7s. 6d.)	10 0	10 0
Rose Deep (9s. 6d.)	12 6	13 6
St. Helena (10s.)	1 19 6	2 2 0
Simmer and Jack (2s. 6d.)	4 3	4 3
South African Land (3s. 6d.)	1 1 6	1 2 0
Springs (5s.)	1 9	2 0
Stilfontein (5s.)	1 19 6	2 1 6
Sub Nigel (10s.)	15 0	13 6
Vaal Reefs (5s.)	1 17 0	1 17 3
Van Dyk (9s.)	4 6	4 6
Venterspost (10s.)	13 3	14 9
Virginia (5s.)	7 6	8 0
Vlakfontein (10s.)	16 0	16 9
Vogelstruisbult (10s.)	9 0	9 0
Welkom (5s.)	12 3	13 9
West Driefontein (10s.)	4 13 0	4 17 6
West Rand Consolidated (10s.)	1 5 6	1 5 0
West Witwatersrand Areas (2s. 6d.)	2 0 6	2 3 9
Western Holdings (5s.)	4 7 3	4 13 0
Western Reefs (5s.)	1 6 0	1 6 0
Winkelhaak (10s.)	16 6	17 0
Witwatersrand Nigel (2s. 6d.)	1 3	1 6
RHODESIA:		
Cam and Motor (2s. 6d.)	8 0	8 6
Chicago-Gaika (10s.)	15 0	15 3
Coronation (2s. 6d.)	3 6	3 6
Falcon (5s.)	6 6	7 0
Globe and Phœnix (5s.)	1 6 3	1 6 6
Motapa (5s.)	6	6
GOLD COAST:		
Amalgamated Banket (3s.)	1 3	1 3
Ariston Gold (2s. 6d.)	4 3	4 6
Ashanti Goldfields (4s.)	14 9	15 9
Bibiani (4s.)	1 9	2 3
Bremang Gold Dredging (5s)	1 6	1 6
Ghana Main Reef (5s.)	1 9	2 0
Konongo (2s.)	1 6	1 7
Kwahu (2s.)	2 6	3 0
Taquah and Abosso (3s.)	6	—
Western Selection (5s.)	4 9	4 9
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	1 0	1 6
Gold Mines of Kalgoorlie (10s.)	8 0	7 9
Great Boulder Propriet'y (2s.), W.A.	11 6	12 0
Lake View and Star (4s.), W.A.	1 2 3	1 2 3
London-Australian (2s.)	9	—
Mount Morgan (10s.), Q.	6 6	7 3
New Guinea Gold (4s. 3d.)	1 3	1 3
North Kalgurli (1912) (2s.), W.A.	7 3	7 6
Sons of Gwalia (10s.), W.A.	2 3	2 3
Western Mining (5s.), W.A.	7 9	8 3

MISCELLANEOUS:	May 6, 1958 £ s. d.	June 9, 1958 £ s. d.
Fresnillo ($1·00)	2 5 0	2 3 9
Kentan Gold Areas (1s.), E. Africa	3	2
St. John d'el Rey, Brazil	2 8 3	3 1 3
Yukon Consolidated ($1)	4 9	5 3
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	15 9	15 9
Esperanza (2s. 6d.), Cyprus	1 2	1 2
Indian (2s.)	3 6	3 6
Magundi (5s.)	2 6	2 6
Messina (5s.), Transvaal	3 17 6	4 6 3
Mount Lyell, Tasmania	16 6	16 0
Nchanga Consolidated, N. Rhodesia	10 0 0	10 1 3
Rhokana Corporation, N. Rhodesia	25 15 0	27 0 0
Roan Antelope (5s.), N. Rhodesia	7 9	8 3
Tanganyika Concessions (10s.)	2 14 6	3 1 0
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	2 8 3	2 7 6
Burma Mines (3s. 6d.)	1 6	1 6
Consol. Zinc Corp. Ord.	2 4 6	2 4 3
Electrolytic Zinc, Tasmania (Pref. 5s.)	2 12 6	2 12 6
Lake George (5s.), N.S.W.	3 3	4 0
Mount Isa, Queensland (5s. Aust.)	1 0 9	1 2 0
New Broken Hill (5s.), N.S.W.	1 10 0	1 11 6
North Broken Hill (5s.), N.S.W	3 8 6	3 13 6
Rhodesia Broken Hill (5s)	7 3	8 0
San Francisco (10s.), Mexico	15 0	15 3
TIN:		
Amalgamated Tin (5s.), Nigeria	5 3	5 0
Ampat (4s.), Malaya	7 0	6 3
Ayer Hitam (5s.), Malaya	1 2 6	1 2 6
Beralt (5s.), Portugal	1 4 6	1 5 0
Bisichi (2s. 6d.), Nigeria	3 3	3 3
Ex-Lands (2s.), Nigeria	1 9	1 9
Geevor (5s.), Cornwall	15 0	14 6
Gold Base Metals (2s. 6d.), Nigeria	9	9
Hongkong (5s.), Malaya	5 3	4 6
Jantar Nigeria (3s.)	2 3	2 0
Kaduna Syndicate (2s.), Nigeria	2 0	2 0
Kamunting (5s.), Malaya	8 6	8 0
Kramat Pulai (3d.), Malaya	3 0	2 9
Malayan Tin Dredging (5s.)	11 0	10 9
Mawchi Mines (4s.), Burma	2 0	1 9
Naraguta Extended (5s.), Nigeria	1 0	9
Pahang (5s.), Malaya	4 6	4 3
Siamese Synd. (5s.)	7 9	7 0
South Crofty (5s.), Cornwall	5 9	4 3
Southern Kinta (5s.), Malaya	16 3	16 0
Southern Malayan (5s.)	8 6	8 3
Southern Tronoh (5s.), Malaya	8 0	7 6
Sungei Besi (4s.), Malaya	13 3	12 9
Sungei Kinta, Malaya	15 3	15 3
Tronoh (5s.), Malaya	10 0	9 9
United Tin Areas (2s. 6d.), Nigeria	4½	5
DIAMONDS:		
Anglo American Investment	7 18 0	8 13 0
Consol African Selection Trust (5s.)	12 0	13 0
Consolidated of S.W.A. Pref (10s.)	10 9	11 0
De Beers Deferred (5s.)	4 14 0	5 1 0
FINANCE, ETC.		
African & European (10s.)	2 18 9	3 1 3
Anglo American Corporation (10s.)	6 6 3	7 0 0
Anglo-French Exploration	1 1 6	1 3 6
Anglo Transvaal 'A' (5s.)	1 11 3	1 13 3
British South Africa (15s.)	2 18 3	3 0 0
British Tin Investment (10s.)	15 3	15 6
Broken Hill Proprietary	1 14 6	1 15 9
Camp Bird (10s.)	8 0	8 0
Central Mining	2 17 6	3 1 9
Central Provinces Manganese (10s.)	1 8 6	1 7 0
Consolidated Gold Fields	2 12 0	2 14 0
Consolidated Mines Selection (10s.)	1 10 6	1 13 3
East Rand Consolidated (5s.)	1 3	1 6
Free State Development (5s.)	4 0	4 0
General Exploration O.F.S. (2s. 6d.)	2 9	3 0
General Mining and Finance	4 4 3	4 13 0
H.E. Proprietary (5s.)	7 6	7 6
Johannesburg Consolidated	2 5 0	2 8 0
London & Rhod. M. & L. (5s.)	7 9	7 3
London Tin Corporation (4s.)	7 0	7 3
Lydenburg Est. (5s.)	11 6	12 6
Marsman Investments (10s.)	2 0	2 0
National Mining	1 0	1 9
Rand Mines (5s.)	3 15 0	4 0 0
Rand Selection (5s.)	1 17 0	1 19 0
Rhodesian Anglo American (10s.)	3 7 6	3 10 0
Rhodesian Corporation (5s.)	3 9	3 9
Rhodesian Selection Trust (5s.)	16 3	16 6
Rio Tinto (10s.)	2 19 0	2 19 3
Selection Trust (10s.)	3 5 9	3 15 9
South West Africa Co. (3s. 4d.)	16 3	11 3
Union Corporation (2s. 6d.)	1 18 6	2 0 6
West Rand Inv. Trust (10s.)	2 6 6	2 9 3
Zambesia Exploring	2 2 6	2 5 0

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Cathodic Protection for Buried Metal

In Information Circular 7827 of the United States Bureau of Mines J. H. Bird and A. Z. Dimitroff discuss "Cathodic Protection for Earth-Buried Pipelines and Other Metal Structures." It is stated that grounding of electrical equipment and metal structures for the purposes of protecting personnel from shock hazards, preventing damage to equipment, and minimizing property loss has been generally accepted by industry. However, the very requirements that make a grounding system or medium satisfactory from the standpoint of shock hazards—such as, conductivity and ability to absorb or dissipate static charges or stray electric currents—may be the most detrimental factors when corrosion is considered. The earth's properties as a grounding medium and grounding systems in general are obviously integral parts of corrosion prevention.

The authors say that protection from corrosion is not generally given enough consideration by the mining industry, perhaps because the theory of corrosion is not fully understood. It should be pointed out, however, that the actual annual damage due to corrosion is high. One estimate, which includes not only actual metal loss but also maintenance costs, claims a yearly loss of $5,500,000,000 in the United States from corrosion. This same source estimates the annual loss to the world from wasted iron and steel alone at £600,000,000 sterling.

Because of the rather complex nature of corrosion theory and for the sake of simplicity, only electrochemical corrosion is considered in the circular. This type of corrosion is the main offender when buried structures are considered. Virtually all corrosion involves electrochemical action; even surface oxidation of metals is believed to be of electrochemical nature. According to the electrochemical theory of corrosion, the damage results from detachment or replacement of ions from the metal surface involved. This action involves an actual flow of electric current induced by an electromotive force or simply the establishment of a potential difference, which induces a transfer of ions.

A galvanic effect results when dissimilar metals are buried in the ground. In such an instance the soil acts as the electrolyte. However, dissimilar metals are not essential for a galvanic-cell type of corrosive action. A galvanic-cell effect involving only one type of metal may also result from a variation of the soil resistivity or merely from the difference in oxygen concentration. Differences in oxygen concentration will tend to set up galvanic action that is characterized by an anodic area in the oxygen-deficient portion. When two electrodes are involved the cathode is protected from deteriorating or corroding at the expense of the anode. Consequently a metal structure that is made the cathode of a cell can be protected from corrosion because damage results at the point or points where the electric current leaves and not at points where it is received. The term "cathodic protection" is descriptive of the protective method, since it implies that the protection is accomplished by making the structure to be protected the cathode of a cell, thus receiving the current. Even though such protection was suggested as early as 1823 in conjunction with ship-hull protection, its extensive use has been developed only recently. Cathodic protection is usually accomplished by using two types of anodes, the galvanic anode or an electrolytic anode.

The galvanic anode, when used, is of a metal less noble or higher on the electromotive series. Thus, when connected to the metal structure that it is to protect, it becomes the anode of the cell, providing protection to the structure at its expense (deterioration). These anodes are commonly referred to as "sacrificial" anodes. When they are used they operate automatically without the need of external power. For this reason use is made of them in isolated places or to protect individual structures for which it is not desirable to provide electric power. Galvanic anodes are most commonly used to protect tower footings, brine-storage tanks, and water tanks. To protect industrial black-iron hot-water tanks, brine tanks, and home-heaters magnesium anodes are commonly installed in the tanks. For external protection of tanks in contact with the earth the anodes are buried near by. Factors that govern cathodic protection installations and energy required are: The area of surface exposed to corrosion; the soil resistivity involved; the type of surface, and the current density.

In cathodic protection when electrolytic anodes are used electrical energy must be provided in the form of direct current from an external source. Rectifiers of various sizes and motor-generator equipment are used as sources of energy. This type of protection is generally used where considerable surface is to be protected and is extensively employed to protect pipelines. The authors believe that better understanding of the principles involved can be obtained if an existing system is used as an example; consequently, reference is made to the cathodic protection practices of the El Paso Natural Gas Co. This was chosen because it is a typical cross-country pipeline protective system and also because, due to its location, problems from interference, such as would be found in congested industrial areas, are not present.

The main lines of the San Juan Division, consisting of 1,800 miles of 24-in. and 30-in. pipe in New Mexico and Arizona, distribute natural gas and

deliver it to the California State line. By September, 1956, cathodic protection had been provided for 75% of these main-line installations and full coverage was anticipated. Secondary and gathering pipelines were protected only at trouble spots, except for an unusually corrosive field, which had full protection. Direct-current power was provided by 55 rectifier units of various sizes. Where cathodic protection is provided for pipelines on the field 100% corrosion protection is expected ; however, at plant locations only about 80% corrosion protection is considered within the practical scope. The numerous pipes and metal structures in the ground, because of their position with respect to each other, tend to shield some sections and prevent proper distribution of current. In new installations where extensive networks of pipes are to be used proper grouping and bonding of pipelines can doubtless minimize cathodic-protection problems. In extremely congested underground areas where weather conditions and the substances handled through the pipelines are such that aerial suspension is possible the current required and problems connected with its proper distribution can be alleviated by such installations.

When external power in the form of direct current is used it is supplied to the structure to be protected through anodes or " anode beds." The negative conductor is welded to the structure and the positive conductor is connected to the anode. The term " anode bed " refers to two or more anodes that are interconnected and operated as a unit. The number of anodes used is determined by the current required and its distribution. The El Paso Natural Gas Co. limits the current per anode to a 4-amp. maximum. In plants anodes are distributed throughout the area according to anticipated current-density demand. A definite pattern is not followed, except that anodes are not installed closer than 10 ft. to any pipelines or other buried structures that are to be protected. Anode beds used for pipeline protection are laid out in an " H " pattern. The anodes are installed along the two parallel lines and interconnected with low-voltage buried cable that is carried underground to the rectifier or generator.

In order to obtain good distribution of current the anode beds are placed not closer than 350 ft. at a right angle to the pipeline. The average bed consists of 20 graphite anodes. The size of anode is not standardized and both 3 in. by 60 in. and 4 in. by 80 in. graphite rods are used. Anodes are installed underground either horizontally or vertically. Coke-breeze backfill is used to obtain more contact surface, which results in lower resistance. This method of installing the graphite essentially increases the anode life. A well-insulated positive conductor cable to the anodes is essential because slight damage to the cable will result in leakage of current.

Owing to the nature of this type of protection the actual cost will be governed to a great extent by the electric-power demand whether galvanic or electrolytic anodes are used. The type of surface to be protected, therefore, will be a primary factor in determining protection costs. Bare metal surfaces can have current demands that will make cathodic protection uneconomical. In pipeline protection a good insulating coating is desirable. If corrosion is due mainly to the outward flow of stray or natural currents from a structure it is logical that protective insulating coatings will reduce such current movements and the counter-currents necessary to nullify them. The question " Why cathodic protection if pipelines are thoroughly insulated ? " may arise in the reader's mind. El Paso Natural Gas Co. has found that coated pipes develop leaks even faster in spots than bare lines, because of concentrated local corrosive action. A 10-year record of one of the company's protected lines, on the other hand, has shown no corrosive leaks, while spot leaks developed on unprotected lines within a year.

The corrosion picture, as presented so far by the authors, has been viewed only from the natural-corrosion side. Stray electric currents, though not present in many industries, do real damage in mines and should be given due consideration. Because of the extensive use of direct-current electrical equipment in and about mines corrosive damage from stray electric current is always present. Such damage can become serious in a relatively short time. In one instance of stray-current damage cited by a mining company mine-pump maintenance costs increased more than 120% of normal within a year and at times pumping equipment needed reconditioning after two weeks of operation. Damage was determined to have been caused mainly by stray currents from the 250-V. direct-current mine-haulage system.

Often the power return of trolley-locomotive haulage systems is not adequately considered. Many systems use the track as a power-return conductor without additional copper or aluminium. In such instances lack of an effective track bonding and maintenance programme will obviously intensify circulation of stray currents. Such a condition is not only desirable from the power-distribution point of view but also because of corrosion damage due to stray currents. In mines where considerable electric power is used integration of all metal—water lines, air lines, metal cable sheaths, and cable armour—is considered good practice. Thus the metal can be kept at earth potential by connecting it at regular intervals to the grounding medium. (Airdox lines are an exception.) This practice tends to minimize the establishment of potential differences, will minimize the possibility of arcing, and will provide shock protection for persons. However, it does not eliminate circulating currents. In Airdox systems, for instance, where circulating currents are undesirable, it is common practice to use insulating couplings at regular intervals. These couplings can also be used to advantage to insure isolation of a piece of equipment (a pump, for instance) where corrosive damage can result owing to electric current.

Because both cathodic-protective systems and shock protective grounding are based on establishing a low-resistance contact with the earth at the point of earth contact they can be combined. In many surface installations where cathodic protection is used, the anode beds or individual anodes are used as grounding mediums for the protective grounding system. When copper rods or cables are employed as grounding mediums owing to the position of copper with respect to iron in the electromotive series, the copper will receive cathodic protection at the expense of any iron or lead grounded to it. A system where considerable copper is used as a grounding medium is also difficult to bring under cathodic protection because copper tends to collect the current. In such instances grounding rods of a different metal—such as, iron or zinc—for which cathodic protection is provided, would be advisable.

Conclusions

(1) Loss of metal and damage to buried metal structures because of corrosive action is, to a large extent, determined by the soil resistivity in the immediate vicinity of the structure. The intensity of corrosive action is inversely proportional to the soil resistivity—that is, corrosive action will increase as the soil resistivity is lowered.

(2) Moisture is one of the main factors that affect soil resistivity. It also affects the resistivity with respect to earth of grounding mediums. If the moisture content of the soil surrounding a grounding medium varies seasonably, it will tend to make the resistivity with respect to earth of that medium fluctuate.

(3) Multiple grounding rods or integration of two or more grounding mediums is desirable to reduce resistivity fluctuations and provide lower ohmic values.

(4) Integration of all metal structures and provision of a good power return for direct-current systems will tend to minimize circulating currents and reduce damage to equipment. Where circulating currents should be eliminated insulating couplings can be used to advantage.

(5) Cathodic protection can be used to mitigate corrosion of buried structures or provide spot protection from corrosive action for surface structures. Such protection can (in many instances) be used with a well-designed protective grounding system.

(6) Corrosion-prevention programmes using cathodic-protection principles can be used advantageously in many mining installations. On the other hand, cathodic-protection systems requiring heavy currents would not be desirable in mines where explosion or other hazards would be introduced if ground circulating currents are introduced.

Hartebeestfontein Reduction Plant

A description of the plant at Hartebeestfontein Gold Mining appears in the *South African Mining and Engineering Journal* for May 2 and the following notes are abstracted. The *Journal* calls attention to the imminent commissioning of the 6,600-h.p. winder at the mine and, in due course, the opening up of the deeper section of the property *via* No. 2A sub-vertical shaft. These are steps towards increasing the milling rate to 100,000 tons a month. The reduction plant at this property, it is stated, incorporates a number of unusual features.

Ore is hoisted at No. 2 shaft into headgear bins and fed by conveyor on to a stockpile of 4,000 tons live load. From the pile ore is carried by a 42-in. conveyor to 5½-in. spaced grizzlies ahead of a jaw-crusher. This belt and the one following have a slope of 10° instead of the more usual one of 18° as a precaution against possible sliding of wet fine run-of-mine rock. Undersize from the grizzlies and crusher product are fed on to a 36-in. conveyor for transport to the washing and screening plant. Here it is split on to two 4 ft. by 12 ft. Allis Chalmers extra heavy duty Lowhead screens with 1½-in. square apertures. Over each screen are spray pipes which subject the rock to a wash with water pressure of 60 lb. per sq. in. Oversize from the screens passes on to Allis-Chalmers Rifts with 2-in. apertures where further washing takes place. Oversize from these then goes on to the reef picking belts.

The undersize from the Lowhead screens feeds on to 5 ft. by 12 ft. Allis-Chalmers standard single-deck Lowheads with 2 in. by ⅜ in. slotted wire mesh screens. It has been found that increased screen-cloth life and greater capacity are obtained by fitting the screens with the long axis of the slot at right angles to the flow of ore. The oversize is conveyed by belt to the Symons crusher bin. The fines washed through the screens pass through a safety box to three 54-in. Simplex classifiers which also handle all belt washings, collected dust, and spillage. Oversize from the 4 ft. by 10 ft. screens is washed again on the inclined sections of the picking belts.

Reef picking owes its success to the fact that the percentage of reef in the coarser fractions of run-of-mine ore is small. Nevertheless it requires very efficient washing of the ore and close supervision of picking boys. Experiments with radiometric equipment for continuous monitoring of waste rock were tried, but for a number of reasons did not prove successful. Reef picked from the belts drops through chutes on to other belts, which also carry the undersize of the Riflo screens delivering to the tubemill pebble storage bin. Rock remaining on the picking belts is transported to the waste dump.

Ore from the pebble bin and the oversize from the Lowhead screens feeds to two standard Symons and three Shorthead crushers by variable speed belts carried on retractable carriages to facilitate maintenance work on the crushers. The product from the Symons crushers is fed to Symons rod-deck screens with ⅜-in. rod spacing in the washing and screening building. The oversize joins that from the low-head screens to feed the short-head crushers and the undersize combining with the classifier underflow to form the mill feed. The overflow from the classifier is pumped into a 75 ft. by 10 ft. thickener, from which the pulp goes to the tertiary mill circuit. Overflow water from the thickener is used for screen sprays, belt sprays, and the like. Dust is controlled by fans exhausting through wet collectors. These are cleaned out periodically and pumped to the classifiers.

The mill is based on the unit system, each having its own fine-ore bin with a live capacity of 1,350 tons. Each mill unit consists of one 8 ft. by 12 ft. mill run at 19·5 r.p.m. in closed circuit with a 78-in. Simplex Akins classifier, one 9 ft. by 16 ft. secondary tube mill at 22·2 r.p.m. in closed circuit with a 22-in. 20° cyclone, and two 8 ft. by 16 ft. tertiary tube-mills at 22·4 r.p.m. in closed circuit with two 24-in. 20° cyclones. The final pulp is pumped to the thickeners in the cyanide unit, the overflow being circulated back to the mill.

Mill concentration of gold is not practised at Hartebeestfontein now as it was found that the percentage of gold recovered was too low to justify the cost.

Each of the unit silos is fitted with three discharge doors and the feed to the rod mills recorded on weightographs. The rod-mills and the secondary

tube-mills are in line of the bin side of the mill building with the Akins classifiers between the two mills of each unit. The classifier is installed on a steep slope of 5½ in. per ft. and it is thus possible to close the rod-mill circuit without using a scoop feeder. A splitter allows the rod-mill circuit partially or completely by diverting Akins returns to the tube-mill. The classifier overflow joins the secondary mill effluent and is pumped to the 27-in. cyclone at the feed end of this mill.

The tertiary mills are in line on the other side of the building, the centre portion having the submerged sumps below floor level. These take the overflow from the 27-in. cyclones and tertiary mill effluents. Prima screens with ⅝-in. holes are used in both secondary and tertiary mills, which makes it unnecessary to provide facilities for removing reject pebbles before pumping effluent pulps. Pebbles are conveyed by belt from the crusher plant and passed over a 2½-in. grizzly. The oversize going to the secondary mill storage bin and the undersize the tertiary bin. They are distributed from these by monorail trucks to hoppers at the feed end of the mills. The trucks, originally manual operated, are being mechanized. Feeding of pebbles to the mills is at present manual.

It is at this stage of the process that a unique feature is introduced—the thickened pulp from the mill is pumped first to the " U " plant for the extraction of uranium before being returned to the cyanide section of the reduction plant for the extraction of gold. This " reverse leach " is the result of a proportion of the gold in the reef on this property being coated with a thin layer of uranite which prevented all the metal being dissolved by cyanide. The introduction of the process has resulted in an additional 2% dissolution of gold. Since slimes accumulated prior to the start of the uranium plant is being reclaimed for uranium recovery most of this old residue has become available for retreatment in the cyanide plant which has a capacity of 110,000 tons a month compared with the milling rate at present of 85,000 tons a month.

The pulp from the uranium plant is pumped into nine 75 ft. by 10 ft. by 7 ft. 6 in. cone thickeners. The high clay-minerals content of the Vaal reef makes settling and filtering difficult and is responsible for this large thickening section. The thickened pulp contains a high percentage of water, but this is not of such great economic significance as would have been the case had the normal gold-uranium process been maintained.

Slaked lime pumped from the uranium plant is added to the pulp at the thickener distributors. Neutralization of the cake from the secondary acid filters in the " U " plant is conducted in pachucas. Thereafter the pulp is transferred to the 17 22 ft. 6 in. diameter by 45 ft. Brown tanks where cyanide dissolved in by-pass solution is introduced. Contact time is 24 hours.

The ten 18 ft. diameter by 16 ft. Oliver filters, fitted with variable-speed drives, are run at as low a speed as possible commensurate with the capacity required. The clay-like pulp texture makes it most important to maintain full vacuum and an even wash to keep gold losses at a minimum. Five Ingersoll-Rand type reciprocating pumps at present provide the vacuum and an additional one is being installed.

The filter cake is discharged on to a conveyor-belt, mixed in repulpers with excess barren solution, and delivered to the slimes dam. The pregnant gold solution is passed through four large sand clarifiers and from there passes through four standard 40-leaf Merrill filter tanks, with two Crowe de-aerating cylinders in the zinc dust precipitation plant. Lead nitrate is fed to the solution prior to de-aeration and zinc dust to the Merrill emulsifiers by belt. From this the product passes to the smelt house.

Sand Treatment at an Idaho Mill

In the *Mining World* of San Francisco for May S. H. Dayton describes how " Radioactive Black Sand is Yielding Columbite Concentrate at Idaho Mill." The author says that the " unusual " mill erected by the Porter Bros. Corporation at Lowman, Idaho, produces over 90% of the United States output of columbium-tantalum concentrate by a combination of electromagnetic, high-tension, and gravity separation methods. With a capacity of 150 to 200 tons a day the plant was put into operation in 1955. Treatment involves beneficiation of jig-concentrated black sands which carry euxenite. The plant is turning out two main products—a columbite-euxenite and a monazite concentrate *plus* a host of potentially valuable by-products—such as, magnetite, ilmenite, zircon, and garnet. Mill feed is obtained from placer deposits in Central Idaho. Since 1955 the Porter Bros. Corporation has been dredging gravels at Bear Valley, 20 miles north of Lowman, to recover heavy minerals. The sands recovered contain a wide range of minerals including: Euxenite, fergusonite, brannerite, xenotime, monazite, ilmenite, garnet, zircon, columbite, and ilmenorutile. Euxenite is found in amounts of 1·0 lb. per yd.; columbite averages 0·2 lb. per yd.; monazite occurrence is 0·5 lb. per yd. and magnetite, ilmenite, and garnet make up 85% of the remainder.

Physical properties of the heavy minerals overlap in many cases; hence, it is necessary to resort to a combination of methods to recover the valuable products. Essentially electromagnetic separation is used to scalp out minerals of high magnetic susceptibility—such as, magnetite and ilmenite. Subsequently monazite and columbite-euxenite are separated by high-tension means. Air tabling and wet tabling are then used to up-grade the high-tension concentrates.

Basically the milling process consists of a wet circuit and a dry circuit. In the wet portion of the plant blended black sand is rod-milled to *minus*-0·064-in. size (about *minus* 12-mesh Tyler) and the major portion of the magnetite is removed by a Stearns MWI Crockett-type electromagnetic separator. Two Dorr 2 ft. by 15 ft. classifiers deslime the feed, removing 2·70 specific gravity solids at *minus*-65 mesh from the black sands.

In the dry circuit ilmenite, garnet, and a small amount of magnetite are first removed by two twin Stearns four-roll induced-roll separators. A

bulk columbite-euxenite product is separated from monazite in a Carpco HT 460, four-roll, high-tension separator. Columbite-euxenite and monazite are then separately and alternately treated after being split into *plus*- and *minus*-0·028-in. size fractions in a single gravity concentration circuit consisting of an air tabling and a wet tabling operation.

Mallinckrodt Chemical Works treats the concentrates on a toll basis for Porter Bros. Corporation. Recovered at the Mallinckrodt plant are columbium and tantalum pentoxides, uranium oxide, and rare earth, titanium, and thorium-iron residues. Porter Bros. Corporation holds a contract with the Atomic Energy Commission for the sale of the uranium oxide. It holds a contract with the General Services Administration covering the sale of the columbium-tantalum pentoxides to the federal stockpile. Monazite concentrate from the Lowman mill is sold directly to metallurgical processors.

Separation of the Bear Valley black sands has been found to be most effective when the feed has been reduced to *minus*-12-mesh. The relative conductance of minerals arranged in increasing order are: Silicates, phosphates, carbonates, oxides, and sulphides.

The dredge concentrates, trucked 20 miles from Bear Valley to Lowman, are dumped on a stockpile area level with a concrete-lined crude-ore bunker at the mill. They are bulldozed into the bunker as necessary to provide mill feed. A small Hough loader, operating on a concrete apron forming the floor of the bunker, picks up the black sand and introduces it to a hopper. The sands are belt-conveyed from the hopper to a bucket elevator and discharged to a 14 ft. by 14 ft. steel bin serving the wet circuit of the mill. The dredge concentrate is fed to a Tyler 4 ft. by 8 ft. Hum-mer screen with 0·064-in. openings which is in closed circuit with a Marcy 2 ft. by 4 ft. rod-mill. The screen undersize is washed in a 2 ft. by 15 ft. Dorr classifier. The classifier overflow, which is primarily 65-mesh quartz, is wasted.

The classifier sands are discharged at approximately 75% solids to a Wemco attritioner. This unit essentially consists of the three Fagergren rotors and stators. Agitation in this unit serves to scour and improve the surface properties of the mineral particles for subsequent separation. A 3-in. Vacseal pump introduces the scoured pulp to a Stearns MWI (Crockett-type) magnetic separator where 99% of the magnetite and a small portion of the ilmenite is pulled from the pulp. This high-iron reject is piped to a separate tailing pond where it is stockpiled pending study for possible development of a market. The non-magnetic portion of the pulp treated in the above separator is again washed in a second Dorr 2 ft. by 15 ft. mechanical-rake classifier. The overflow is discharged to the mill tailing pond. The classifier sands are transported to a bucket elevator and transferred to either of two 14 ft. by 14 ft. steel bins.

The feed to these bins has a moisture content of 12% to 15%. Primary purpose of the bins in addition to providing surge capacity for the dry circuit is to allow an approximate 8-hour drainage period for the pulp. Water drains through the discharge opening at the bottom of these bins reducing the moisture content to approximately 8%. This of course reduces the capacity requirements of the subsequent drying step. Drying is carried out in a Cedar Rapids 48 in.-diameter by 16 ft.-long (hot-mix type) rotary kiln fired with a high-grade diesel number 2 oil. The discharge from the drier is taken by a Syntron conveyor to a bucket elevator which deposits the feed in a 14 ft. by 14 ft. surge bin serving the dry circuit.

In the dry circuit black sand drawn from the bin is first delivered to a Stearns MDP (drum-type) electromagnetic separator to pull off a magnetite-ilmenite middling product missed at the separator in the wet circuit. Following this preliminary dry-scalping stage the feed is conveyed by a bucket elevator to a distributor serving two Stearns twin, KT 50, induced-roll machines. A twin induced-roll separator consists of eight horizontal rolls arranged in two vertical rows of four rolls each. Feed to each of the four rows of the two twin units is evenly distributed. The bulk columbite-euxenite-monazite concentrate reports to an oil-fired rotary heater 3 ft. by 8 ft. long. This unit heats the radioactive blacks to 350° C. Hot mineral surfaces serve to aid subsequent high-tension separation of monazite from the columbite-euxenite.

Separation of columbite-euxenite fraction from the monazite fraction is carried out in a Carpco HT 460 high-tension separator. The two roughing rotors make three separations—a columbite-euxenite concentrate for further treatment, a middling product, and a monazite product. The rougher columbite-euxenite concentrate goes to the fourth rotor in the Carpco machine for cleaning. Similarly the rougher monazite product from the roughers goes to the third rotor for cleaning. The middling from each roll (both roughers and cleaners) returns to the feed end of the respective rotor.

From this point on treatment of the high-tension cleaner concentrates—columbite-euxenite and monazite—varies slightly and each is described in separate sections. The final columbite-euxenite fraction from the HT 460 cleaner rotor reports to a Tyler Hum-mer screen which makes a separation at 0·028 in. (about 20 mesh). Both size fractions of the columbite-euxenite product are treated separately in two Stearns two-pole magnetic cross-belt separators. The cleaned monazite fraction recovered is fed to a set of Stearns K 30 induced rolls (four rolls) which are set to reject quartz and a very minor amount of zircon. The rolls are set for maximum amperage and minimum gap for highest flux density. The magnetic fraction monazite from the first roll is cleaned twice. The non-magnetic fraction is scavenged once to make the reject.

The magnetic monazite is cleaned on a 2-pole cross-belt separator. The first pole magnetics, containing mainly garnet and ilmenite, are stockpiled. The second pole magnetics flow to the euxenite crossbelt. The cleaned monazite is screened at 35 mesh on a Tyler Hum-mer screen, both fractions being separately stored for further treatment in the gravity plant.

The two columbite-euxenite concentrate fractions and the two monazite concentrate fractions are treated separately in the gravity circuit, which is fed intermittently with each product. First, the product is introduced to a Sutton, Steele, and Steele air table which makes an air-table concentrate. A middling which is recycled to the table feed and a tailing which is processed on a Diester Plat-O wet table. The Diester wet table makes a wet-table concentrate, a middling which is recycled to the wet-table feed, and a tailing which is wasted.

The air-table and wet-table concentrates are further up-graded on a Stearns four-pole crossbelt.

Mining at Bicroft Uranium

A complete description of "The Bicroft Operation," a uranium mine in the Bancroft area of Ontario, is given by J. D. Bryce, J. M. Thompson, and others in the *Western Mines and Oil Review*, for April. The property consists of an area of 4,800 acres and straddles the favourable geological structure for a strike length of some 3½ miles. Present operations are confined to a length of 3,000 ft. on the south end of this structure. Prior to 1955 the southern half of the property was owned by Centre Lake Mines, Ltd., and the northern half by Croft Uranium Mines, Ltd., a subsidiary of Macassa Mines, Ltd. The mutual advantages offered by amalgamation resulted in the formation of the present company in 1955, with operating control under Macassa Mines. Following amalgamation, a contract was negotiated with Eldorado Mining and Refining, Ltd., the Crown company responsible for uranium procurement, for the sale of $35,805,000 worth of uranium oxide concentrates. This contract provided a basis for arranging the financing required to construct a 1,000-ton-per-day mining and milling plant and to prepare the mine for production. Construction of the plant was started in September, 1955, and production was started 14 months later. Coincidental with the construction of the plant sinking of a new four-compartment production shaft was undertaken and at the same time additional development and stope preparation were started on the one level available at the No. 1 Centre Lake development shaft. It was recognized from the start that, due to the nature of the ore-bodies, the preparation of the mine for production at the required tonnage, on the time schedule necessary, presented the largest problem.

Geology

The radioactive pegmatite dykes in the property occur in a half-mile-wide zone of easterly-dipping folded gneisses of amphibolite-metamorphic rank. These gneisses and the overlying crystalline limestone form part of the Grenville series and are disposed along the south-east flank of the Cardiff pluton, a 50-sq. mile structural component of the Haliburton Highlands. The favourable zone of pegmatite-bearing gneisses extends on the property for a strike length of 3½ miles. However, present mining is confined to a 3,000-ft. zone at the south end of the property where structural and lithological controls have combined to produce a well-defined concentration of ore. Here, in the vicinity of a major synclinal plunging fold, host-rock horizons of garnet-sillimanite gneiss and scapolite gneiss are conspicuous ore localizers, contrasting markedly with biotite-paragneiss and hybrid syenite-gneiss horizons which enclose only barren pegmatites.

Ore-bearing sections of the pegmatites consist of shoots which range between 35 ft. and 200 ft. in length and plunge S. 75° E. at approximately 50°. A single pegmatite body may contain two or three such sections separated by low-grade material; in other cases the entire pegmatite constitutes the shoot. Vertical continuity is excellent compared with the rather tortuous plan form.

Enriched zones are characteristically localized at the foot-wall or hanging-wall contact. Boundaries of the ore may be irregular, but are generally quite definite; the mineralization is not disseminated and gradational, for marginal-grade sections are rather rare and the parts of the dykes which do not make ore are virtually barren. No infallible ore guide is known. High-grade sections are usually distinguished by haematite staining, megascopic uranothorite, and a fine shattering, probably radiogenic. Lower-grade sections, however, will defeat even the most experienced eye and certain "noses for ore" trained on gold-quartz veins have been put severely out of joint when rubbed into these multi-phase, variable ThO_2:U_3O_8 pegmatites. The association of high radioactivity with shattering accounts for the fact that the surface expression of a high-grade pegmatite is usually a heavily overburdened depression unlikely to be touched by trenching or found by radiometric instruments.

Many of the problems connected with both everyday work and long-term planning are fundamentally geological. The scope of geological control has gradually been extended during the past year at the request of the mining department, until the geological staff now comprises seven geologists together with six samplers. An attempt is made to have each breast and face marked daily by a geologist; wherever possible he lays out sufficient work to keep night shift busy as well. His function is to bring his experience to bear on all relevant information from test holes, diamond-drill holes, sections, projections, assays, and geigers and to apply the result to each mark-up.

Mining

When plant construction started in September, 1955, the ore zone presently being mined had been systematically and thoroughly diamond-drilled from surface. Underground development completed was sufficient to confirm the interpretation of the surface drilling but was very limited in so far as production requirements were concerned. A total of 1,347 ft. of driving and cross-cutting was completed on the shallow adit-level which was eventually mined mostly from the first level. The main development had been on the 200-ft. level of the No. 1 development shaft. The topography is such that this eventually connected with the 70-ft. or first level of the No. 2 main shaft, located some 1,800 ft. to the south-east. Driving and cross-cutting here totalled 1,518 ft. and had developed ore lengths totalling 590 ft.

Sinking of the No. 2 main shaft was started in October and at the same time development work on the first level at No. 1 shaft was resumed, using a portable plant. The occurrence of the ore in relatively small lenses, *en echelon*, along the ore zone requires a relatively large amount of both lateral development work and rising. In the 13-month period to October 31, 1956, using a portable-type plant for over half the period and hoisting in one-ton cars, it was possible to complete 14,445 ft. of driving, cross-cutting, and haulageways and 1,434 ft. of stope rising. This driving developed ore lengths totalling 3,500 ft. Stope preparation was carried on at the same time and at the end of the period 34 stopes along an ore length of 3,200 ft. were either in routine operation or under preparation. This development and stope-preparation work involved the hoisting of 82,500 tons of ore and 75,000 tons of waste representing an average of over 400 tons per day. It is evident that if the No. 1 shaft had not been in existence it would not have been possible to get the mine ready.

(To be concluded)

Trade Paragraphs

Climax Rock Drill and Engineering Works, Ltd., of 44, Brook Street, London, W. 1, announce that this is now the address of their London office, the telephone number being Hyde Park 9444. The company's office was for many years at 4, Broad Street Place, E.C. 2.

Armour Chemical Industries, Ltd., of 4, Chiswell Street, London, E.C. 1, has taken over the business of the Chemical Division and the Armour Laboratories, hitherto part of Armour and Co., Ltd. Mr. M. K. Schwitzer, who has been manager of the Chemical Division, continues to be in charge of all the industrial chemicals sold by the new company.

Marshall Sons and Co., Ltd., of Gainsborough, announce that they have concluded a licence agreement for the manufacture of packaged steam and hot water generators, with the Cleaver-Brooks Co. of Milwaukee, Wisconsin. The agreement is in respect of a range of oil burning fire tube units from 500 lb. to 20,000 lb. steam per hour with pressure up to 250 p.s.i.g.

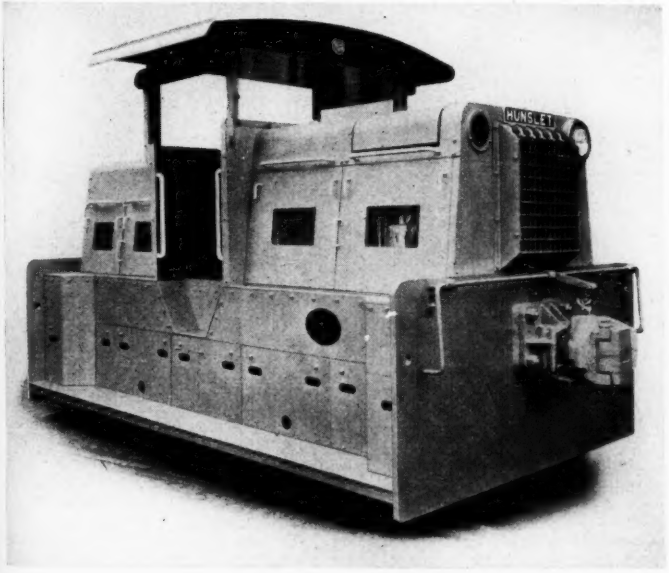
Precision Chains, Ltd., of Clayton Lane, Manchester, announced that they have opened a new works for the manufacture of conveyor chains ranging from 7,000 lb. to 200,000 lb. breaking load and include a series of standard steel bush and roller chains available from stock and described in a new catalogue. The company also manufactures special chains for the mining and quarrying industries.

Mond Nickel Co., Ltd., of Thames House, Millbank, London, S.W. 1, in the *Nickel Bulletin* for March have abstracts of papers on the sintering of nickel oxide at Nicaro, Cuba, and of a bibliography of the extractive metallurgy of nickel and cobalt, as well as one on the vapour pressure of liquid nickel. In addition there is the usual extensive survey of recent work on electro deposition and other working methods on cast iron and constructional steels and on heat and corrosion resisting materials.

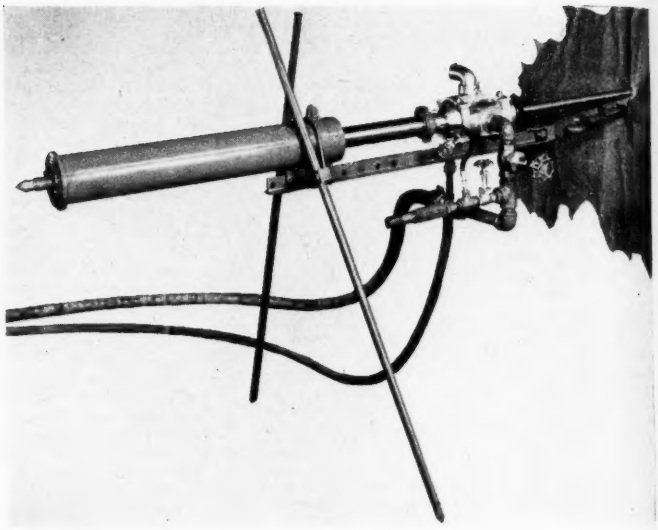
Eutectic Welding Alloys Co., Ltd., of North Feltham Trading Estate, Faggs Road, Feltham, Middlesex, have published a 180-page welding data book, describing simplified welding procedures for application to all metals at reduced temperatures. The pocket-sized book is a guide to improved welding techniques with torch and electric arc and contains useful information on maintenance, repair, salvage, and fabrication with all metals. Procedures are described for obtaining maximum machinability.

Caterpillar Tractor Co., Ltd., of 55, St. James's Street, London, S.W. 1, announce that DW20 and DW21 rubber-tyred tractors are in future to be fitted with the new Super-Turbo engine which has a maximum output rating of 320 h.p. An improvement has been made in the air induction system of the engine to provide higher operating efficiency over a wide range of altitude. It offers not only increased horsepower, but also a significantly improved torque rise characteristic. A new bevel gear and pinion have been incorporated to handle the increased torque.

Hunslet Engine Co., Ltd., of 125, Jack Lane, Leeds, make available some particulars of the latest design of light industrial shunting locomotive the "Yardmaster", which is illustrated here. The locomotive is powered by a Gardner 4LW or Dorman 4LB water-cooled diesel engine developing 71 b.h.p. at 1,700 r.p.m. with electric starter. Transmission from the engine is through Layrub couplings to the torque converter unit and two-speed gearbox. The torque converter is of the simple single-stage type and the gearbox of the constant-



Hunslet 71-h.p. Diesel Hydraulic Loco.



Boyles Bros. Bazooka Diamond Drill.

mesh variety, the two being manufactured as a single assembly to ensure alignment. Ease of gear selection has received special attention, it is stated, and the clutches are of the multi-plate type having sintered metal face linings. A Westinghouse straight air brake and a screw hand brake operate through cast-iron brake blocks on all four wheels. The air supply is maintained by a Reavell compressor.

National Gas and Oil Engine Co., Ltd., of Ashton-under-Lyne, a member of Brush Group of the Hawker Siddeley group of companies, have delivered their first production free-piston gasifier to a large industrial concern in the United Kingdom. Known as the GS.34 the free-piston gasifier is basically a supercharged diesel engine without a crankshaft. Its function is to act as a generator for power gas which is then used to drive a gas turbine and this in turn is coupled to the driven machine. The National gasifier, which is all-British built, first ran in July last year only nine months after the company had obtained the manufacturing licence from Alan Muntz, Pescara, and S.E.P. The gasifyer, in conjunction with the the gas turbine, can provide power in single and multiple units from 1,000 to 20,000 h.p. for electrical generating sets, locomotive traction, and compressor and pumping sets.

Boyles Bros. Drilling Co., Ltd., of Vancouver, (U.K. office : Newcastle-on-Tyne), draw attention to their Bazooka diamond drill to which reference was made in the article on the Sixth Commonwealth Mining and Metallurgical Congress in the January issue of the MAGAZINE. As our contributor pointed out then this is a lightweight drill which is essentially a stoper, is fitted with a rotary vane motor, and as may be seen from the illustration, has an eye-bolt anchor and tripod mounting which needs no back support. Its capacity is given as 200 ft. with E drill rods and 300 ft. with XRT rods. It is further described by the makers as being equally suitable for blast-hole or core drilling. An alternative mounting for the drill is an assembly to fit a 3½ in. or 4½ in. mine bar which allows a full 360° angle range of drilling in both the horizontal and vertical plane. Another alternative is a core for use with a mining bar saddle (rock-drill mounting).

Allis-Chalmers Manufacturing Co., of Milwaukee, Wisconsin, state that the largest materials handling operation in South Africa, a dolomite processing plant, went into production late in 1957. The plant, located at Mooiplaas, near Pretoria, was designed and erected by Edw. L. Bateman, Ltd., the the company's distributor and licensee in South Africa, for the South African Iron and Steel Industrial Corp. The statement goes on to refer to an enormous dolomite deposit in the Mooiplaas area recovery of which consists essentially in blasting the hard rock and moving the 30-in. by 42-in. by 24-in. pieces over more than a mile of conveyors to a 48 in. by 42-in. Allis-Chalmers A-1 jaw-crusher having a capacity of 380 tons per hour. This 80-ton crusher was built by Vanderbijl Engineering Corp., Ltd., to the company's specifications. More than 90% of the total value of the plant was produced in South Africa or South African materials and labour. Other equipment built includes a 5 ft. by 14 ft. double-deck Ripl-Flo screen, a 1051 Hydrocone crusher, and a 5 ft. by 14 ft. double-deck Low-Head screen.

Davies Magnet Works, Ltd., of Ware, Herts., recently issued a leaflet describing the Model No. 1 Premier concentrating table. The approximate feed size range is 10 mesh B.S.S. down to slimes from 300–600 lb. per hour according to material and size. The leaflet points out that flexibility of operation is enhanced through the incorporation of an adjustable stroke from $\frac{5}{8}$ in. to $\frac{5}{16}$ in. allowing both coarse feeds and slimes to be treated with the same deck, while a high pulsation rate of 300 cycles per minute ensures a noteworthy output for a small deck area. The rubber-faced deck ensures long service, giving firm friction faces between the table and the feed particles. Of outstanding importance, it is suggested,

is the facility to control, and set, the slope of the deck in *both* horizontal planes, so that full use is made of all water applied, riffle cut-outs, promoting a quick discharge for the sands. Launders are provided for the collection of all heads, tails, and middlings, adjustable splitters being incorporated to regulate the divisions. A water service is fitted to improve the concentrating action whereby the operator can control the volume applied to any section of the deck, thus increasing efficiency and ensuring absence of " dry spots."

Mechanical Handling Exhibition

The Mechanical Handling Exhibition held at Earls Court, London, from May 7 to 17 contained exhibits on more than 350 stands by companies making materials- and goods-handling equipment of all kinds. Among these were many by companies in the engineering industry who are manufacturers of mining plant and machinery and earth-moving equipment and a selection from these exhibits is given in the notes which follow.

Abisch Conveyor and Furnace Co., Ltd., of 194–6, Finchley Road, London, N.W. 3, were showing a unit construction wire-mesh belt-conveyor and samples of such belt and wire screens and sieves as marketed by the **Industrial Belt and Screen Co., Ltd.,** of the same address.

W. and T. Avery, Ltd., of Soho Foundry, Birmingham, included in their display their constant-rate feeder scale as well as a hopper scale controlled by punched cards.

B.T.R. Industries, Ltd., of Herga House, Vincent Square, London, S.W. 1, exhibited a new fire-resistant conveyor-belt specially designed for carrying loads on steep gradients, shown for the first time. It has specially compounded covers enabling it to carry run-of-mine coal up or down gradients of more than 1 in 3. Also shown for the first time at this exhibition were their V-belts in " grommet " construction. Vibro insulators in a variety of types for mounting heavy vibrating machinery were also displayed.

W. S. Barron and Son, Ltd., of Bristol Road, Gloucester, displayed a range of screw conveying and elevating units suitable for granular material up to 3,000 cu. ft. per hour, as well as bin control gear and level indicators.

Birtley Engineering, Ltd., of Birtley, Co. Durham, from their coal-preparation department at West Bars, Chesterfield, were showing two examples of Birtley-Humboldt dewatering centrifuges which are new in this country and of which some further particulars will be available.

British Ropeway Engineering Co., Ltd., of Plantation House, Mincing Lane, London, E.C. 3, showed a carriage bucket and hanger which was one of 370 similar buckets on order for a heavy-duty bicable aerial ropeway. In association **Drag Scraper and Conveyor Co., Ltd.,** of Regis House, King William Street, London, E.C. 4, displayed scale models of equipment for conveying and storing.

Cable Belt, Ltd., of Longman Industrial Estate, Inverness, exhibited a working model and a full-size built-up section of the special type of conveyor to which attention was first drawn in the MAGAZINE for November, 1954. It differs from conventional types in that the driving pull is taken by two separate steel-wire ropes, one on each side of the conveyor, and not by the belt itself. The belt, of whatever construction (rubber, fabric, composition, etc.), serves only to carry the material being conveyed and engages laterally across the ropes by means of a " shoe form " moulded continuously along the top and bottom of each edge of the belt. The belt shoes are not clamped to the ropes but simply rest on them, the ropes, the belt, and the material being conveyed travelling as one. No troughing idlers are required, the ropes being supported on grooved pulleys.

George Cohen, Sons, and Co., Ltd., of Wood Lane, London, W. 12, occupied two stands, on the larger of which they displayed a range of Jones' mobile cranes, various recent models of which have been described in the MAGAZINE from time to time. The models shown were the KL 33, KL 66, two types of KL 10-6, and the new KL 10-10.

Robert Cort and Son, Ltd., of Reading, demonstrated Cort-Krupp resonance screens to which attention was called in the MAGAZINE in June, 1956. As then stated, it is made under licence from the German designers and has new vibration characteristics with adjustability of both the number of vibrations and the stroke.

Samuel Denison and Son, Ltd., of Leeds, gave a demonstration of their " Blake-Denison " fully-automatic totalizing weigher applied to a conveyor-belt. The equipment is operated by the returning empty belt and is suitable for either horizontal or inclined conveyors.

Dunlop Rubber Co., Ltd., of 10–12, King Street, St. James's, London, S.W. 1, from their belting and engineering components divisions had a representative display of products. The Starwear, a new conveyor belt of cotton and synthetic fibre construction with anti-static fire-resistant cover, was among the range of belts shown. A demonstration model illustrating the stopping power of industrial disc brakes was the feature of another display on the stand. Also shown were engineering components made from Duthane, a new type of synthetic rubber based on polyurethane, and anti-vibration mountings for heavy machinery.

Fisher and Ludlow, Ltd., of Bordesley Works, Birmingham, were showing for the first time their Flexiroll troughing idler system, some features of which are: Nylon bearings which do not require lubrication. No metal-to-metal contact. The idler shapes itself to the load and so helps to prolong belt life.

Goodyear Tyre and Rubber Co., Ltd., of Wolverhampton, had a first showing of their Armadillo chute lining. This is a tough rubber sheet form with abrasion resistance comparable with their Stacker conveyor belting, which belting was also shown. Both are especially suitable for hard rock of abrasive character.

Greenwood and Batley, Ltd., of Leeds, were showing a 6-ton electric-battery mine locomotive, which is one of a range including 8-, 10-, and 12-ton vehicles. The 6-ton model has a drawbar pull of 1,800 lb., a speed (one-hour rate) of 5 m.p.h., and a starting pull of 3,000 lb. in gauges from 18 in. to 42 in. Both flameproof and non-flameproof types of all sizes are available.

International Combustion Products, Ltd., of 19, Woburn Place, London, W.C. 1, had an impressive exhibit of a working twin belt-conveyor system the top section of which was arranged in an aluminium-sheeted gantry. One of the conveyors was fitted with a Pollock sampler, sample crusher, and equipment typical of the complete conveying and sampling equipment installed by the company.

Other products shown included a Dynocone continuous-bowl centrifuge (shown for the first time at this Exhibition), a Tyrock screen, and Vacseal pumps in both rubber-lined and Ferloy metal types, together with a Vacseal sump pump.

W. J. Jenkins and Co., Ltd., of Retford, Notts., had as the principal exhibit on their stand a 15 ft. by 6 ft. S.K.B. high-speed resonance screen with ½-mm. stainless-steel wedge-wire mesh. This is built under licence to the design of Schüchtermann and Kremer-Baum, of Dortmund, and is suitable for throughputs of the order of 400 tons per hour.

C. H. Johnson (Machinery), Ltd., of Adswood, Stockport, in addition to their Hylo-veyor and Loband loader, of which mention has previously been made in the MAGAZINE, were showing a section of Curruband flanged conveyor belting. This is designed for handling material at steep angles without the need for cleats or flare-plates and eliminating troughed idlers. This was demonstrated moving ¾ in. round natural gravel at 27° inclination, the belt exhibited being 24 in. wide and running at 200 ft./minute. It incorporates corrugated flanges 3 in. deep and so designed that belts up to 4-ply can be employed on drums as small as 7½ in. diameter.

(To be concluded.)

RECENT PATENTS PUBLISHED

☛A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

25,764 of 1945 (794,490). R. Q. BOYER and S. B. KILNER. Process for separating uranium.

11,178 of 1954 (794,641) and 16,937–8 of 1957 (794,642–3). SIEMENS AND HALSKE A.-G. Processes for the production of pure silicon and germanium.

15,762 of 1954 (794,906). C. J. CAUSLEY, F. F. W. ROBERTS, and J. Z. YOUNG. Method and apparatus for counting and sizing particles.

24,964 of 1954 (794,480) and 32,359 of 1957 (794,481). HAUSHERR UND ERBEN KOMM.-GES. Rotary and percussive rock-drills.

22,966 of 1955 (794,746). CANADIAN AIRBORNE GEOPHYSICS, LTD. Electromagnetic prospecting apparatus.

6,038 of 1956 (795,116) and 18,278 of 1955 (795,386). IMPERIAL CHEMICAL INDUSTRIES, LTD. Manufacture of titanium.

7,612 of 1956 (795,079). MICROCYCLOMAT CO. Grinding and classification of solid material.

12,014 of 1956 (795,410). SOC. D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE ET DES ACIERIES ELECTRIQUES D'UGINE. Separation of nickel and cobalt.

16,118 of 1956 (795,416). HORIZONS TITANIUM CORPORATION. Production of titanium by the electrolysis of titanium nitride.

16,927 of 1956 (795,419). A. BOECKER. Manufacture of titanium.

20,203 of 1956 (795,291). KLÖCKNER-HUMBOLDT-DEUTZ A.-G. Removal of dust from dust-carrying gases.

30,349 of 1956 (794,327). J.-L. ANDRIEUX and E. BONNIER. Production of calcium.

NEW BOOKS, PAMPHLETS, ETC.

☛Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

Die Blei-Zink-Erzgänge des Schwarzwaldes (Monographien der Deutschen Blei-Zink-Erzlagerstätten 14). By R. METZ, M. RICHTER, and H. SCHURENBERG. Paper covers, 276 pages, illustrated, with 15 plates, and maps. Price 40DM. Clausthal-Zellerfeld: Ges. Deutscher Metallhütten und Bergleute c.V.

Yukon Territory (Geological Survey of Canada Memoir 284). Compiled and Annotated by H. S. BOSTOCK. Paper covers, 650 pages, illustrated, with maps. Price $3·00. Ottawa: Department of Mines and Technical Surveys.

Zinc in Canada, with Comments on World Conditions (Canadian Mines Branch Memorandum Series No. 137). By R. E. NEELANDS and D. B. FRASER. Paper covers, 87 pages. Price 50 cents. Ottawa: Department of Mines and Technical Surveys.

The Industrial Minerals of Newfoundland (Canadian Mines Branch, No. 855). By G. F. CARR. Paper covers, 158 pages, illustrated, with maps. Price $2·00. Ottawa: Department of Mines and Technical Surveys.

Offshore Exploration for Gas Under the Canadian Waters of the Great Lakes (Ontario Dept. Mines Geological Circular No. 7). By A. C. NEWTON. Paper covers, 30 pages, illustrated. Toronto: Department of Mines.

The Geology of the Eastern Portion of the Hartley Gold Belt (Southern Rhodesia Geological Survey Bulletin No. 44). In two parts, Part II—Gold Deposits and Mines. By J. W. WILES. Each part in limp cloth, illustrated, with maps. Salisbury: Geological Survey Office.

Newfoundland: Geology of the Lower Gander River Ultrabasic Belt. Geological Survey Report No. 11. By S. E. JENNESS. Paper covers, 57 pages typescript, with maps. St. Johns, Newfoundland: Department of Mines and Resources.

Nigeria: The Geology of Parts of Niger, Zand, and Sokoto Provinces: With Special References to the Occurrence of Gold. Geological Survey Bulletin No. 27. By W. RUSS. Paper boards, 42 pages, illustrated, with map. Price 15s. Kaduna South: Geological Survey of Nigeria.

Nyasaland Protectorate: Geological Survey Department Report, 1957. Paper covers, 40 pages, with maps. Price 5s. Zomba: Government Printer.

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Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE.

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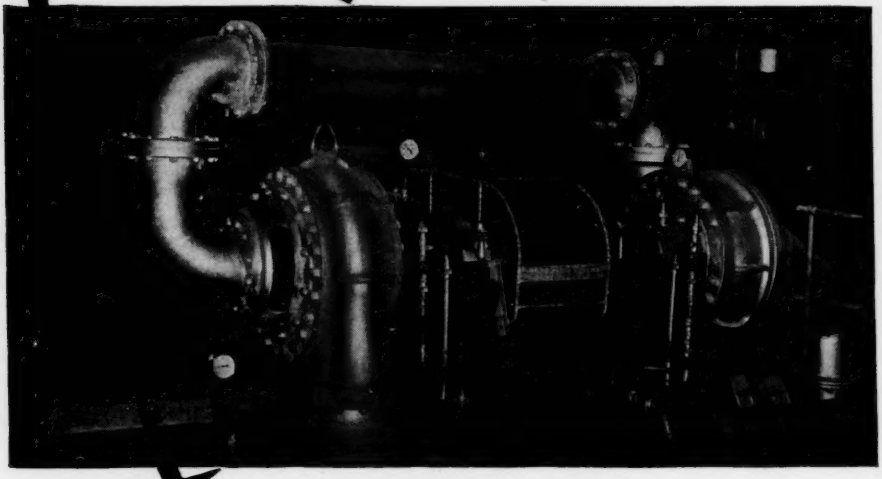

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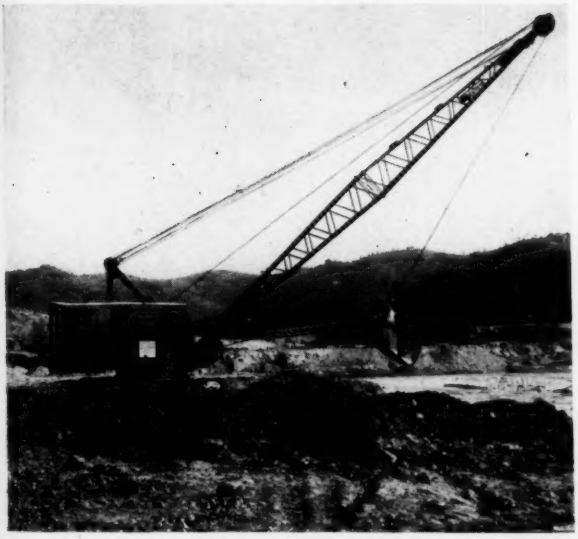

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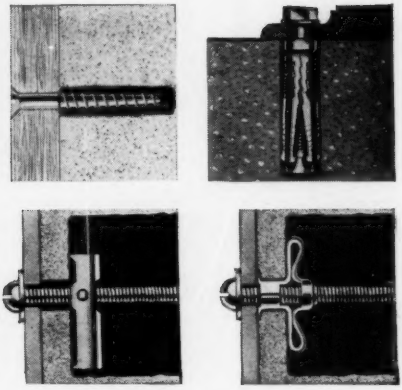

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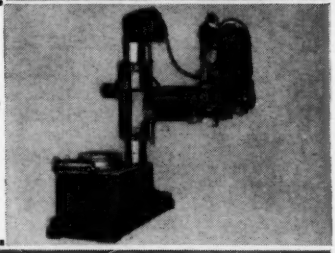

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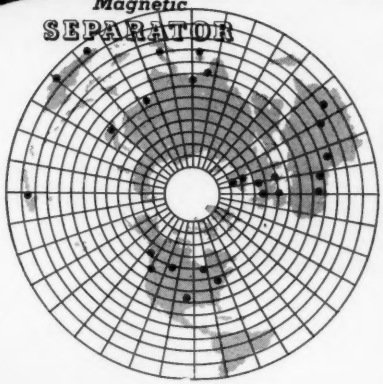

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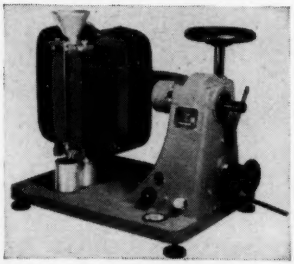

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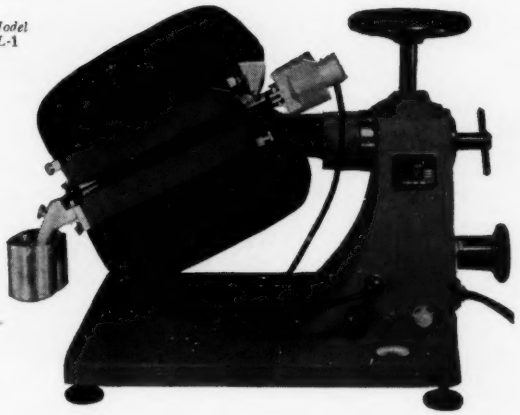

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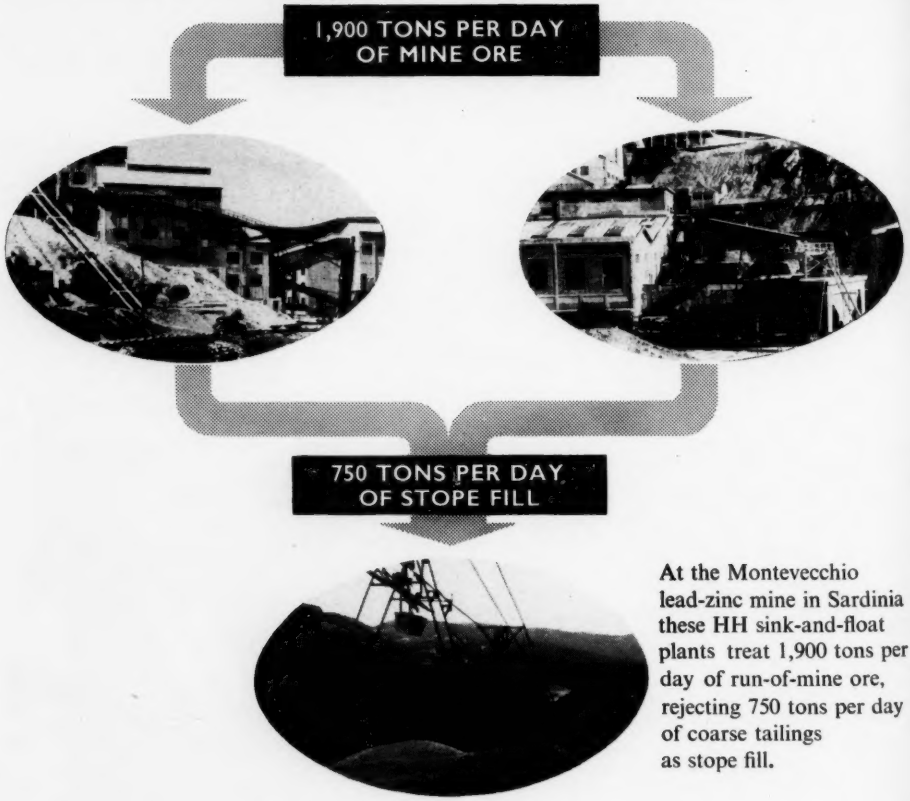

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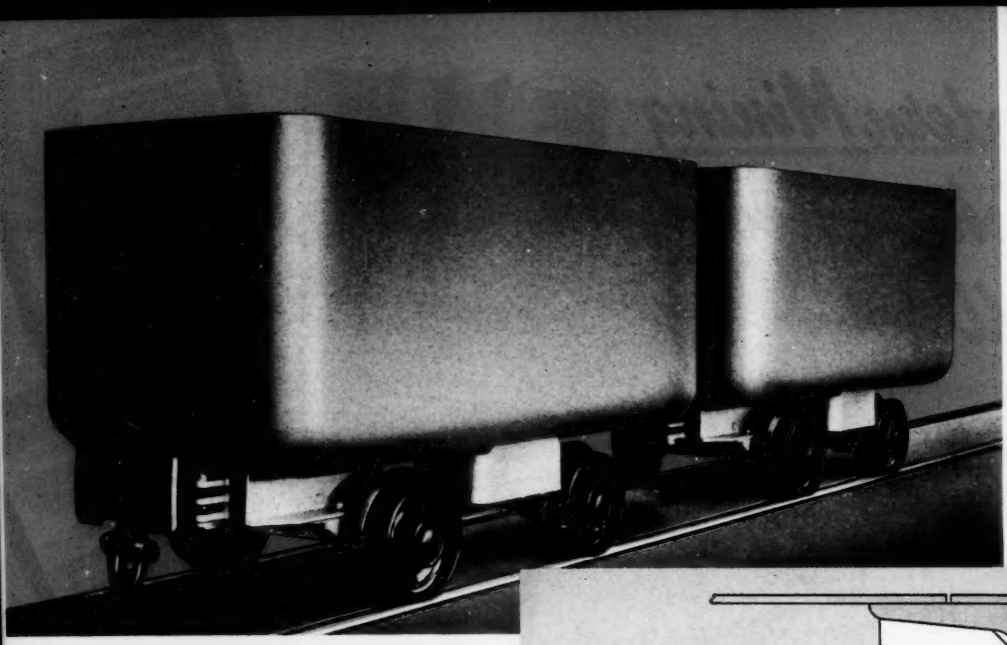

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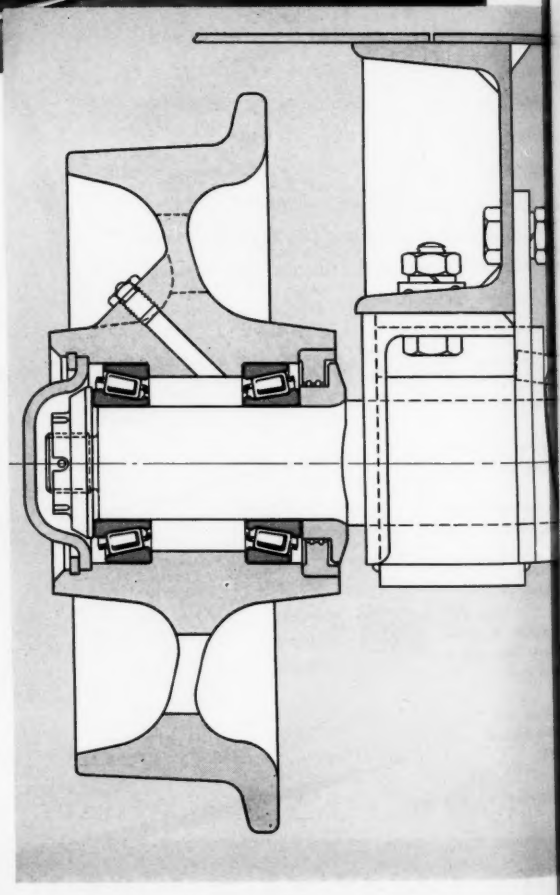

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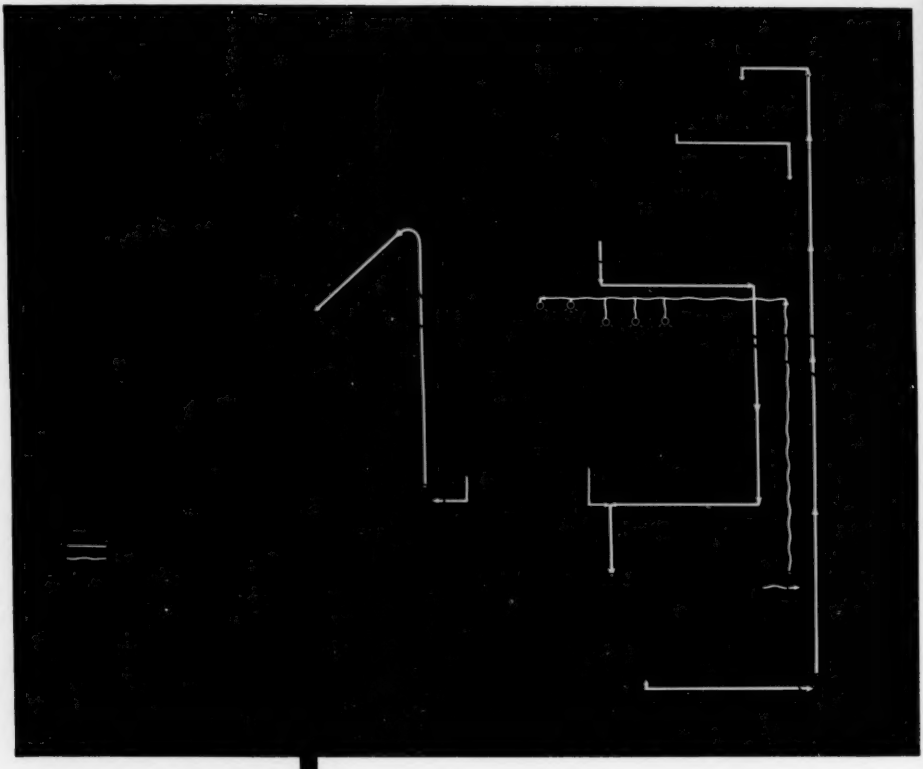

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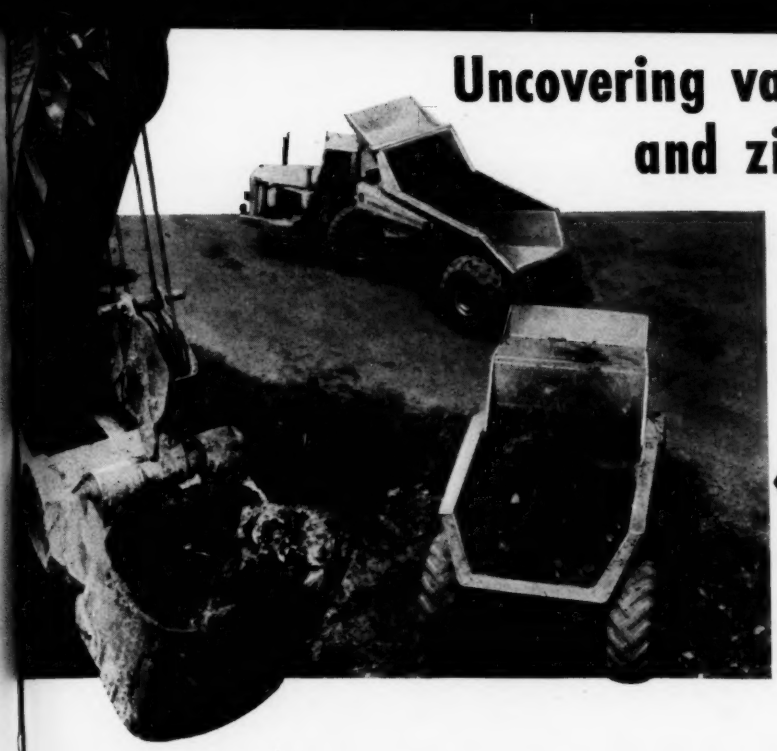

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Combine moves 3,925,000 cu yd of overburden

About 3,925,000 cubic yards of overburden will be hauled away by a combine of German firms: STRABAG-BAU AG., ARTUR SIMON Baugesellschaft mbh., POLENSKY & ZOLLNER and SCHOTTLE & SCHUSTER AG.

Important in the Combine's earthmoving fleet are four Tournapull prime-movers, two equipped with Scrapers, two with Rear-Dumps of 22-ton capacities.

The two Tournapull-Scrapers helped strip off the top 9.8-foot thick layer of boggy topsoil, soft clay, and standstone which covers ore deposits. Each Tournapull moved an average of 40.7 cubic yards of spoil hourly, over typical 4600-foot cycles that included grades of 4.4%.

Rear-Dumps haul rocky waste

Lower levels of overburden, too rocky to be moved by scraper, are blasted and loaded by power shovels. This material is hauled away by Tournapulls equipped with Rear-Dump trailing units, and by conventional trucks.

Shovel-loaded Rear-Dumps haul overburden 3900 feet to the waste dump, partly up grades steep as 10%. Although machines climb as much as 213 feet on the haul, they complete 2½-mile cycles in 15 minutes. Each machine delivers 41.9 yards per hour.

The Tournapulls' power steering system, through a geared kingpin, helps speed operations on the narrow approaches to the shovel and fill, as well as when driving on winding roads. Because of their mobility Tournapulls are outperforming the other 4-wheel and 6-wheel rear-dumps on the project.

LeTourneau-Westinghouse equipment can speed your mining work, too. We shall be pleased to send you complete data on these powerful machines.

Tournapull—Trademark Reg. U.S. Pat. Off. CPCR-1632-MJ-1mm

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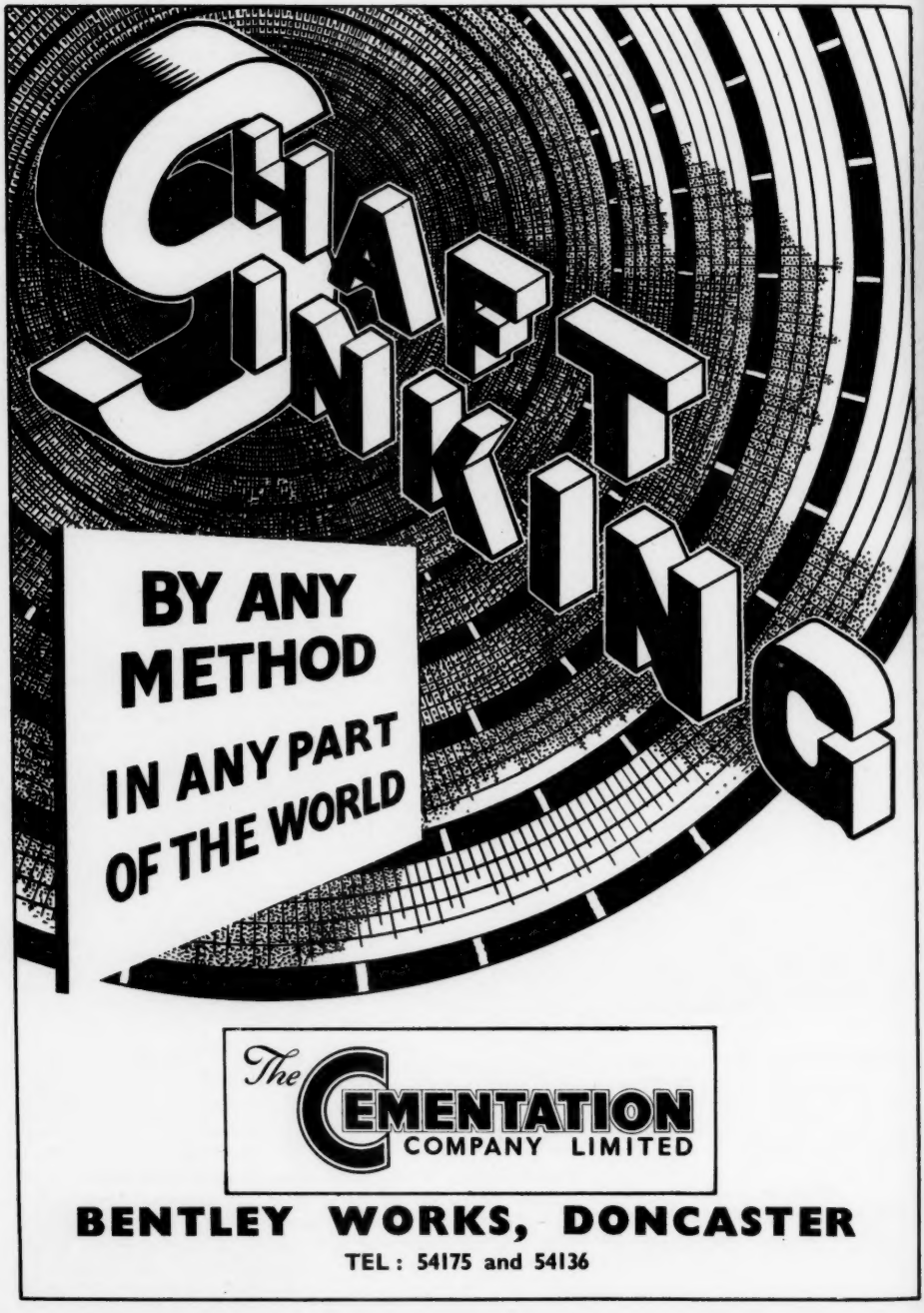
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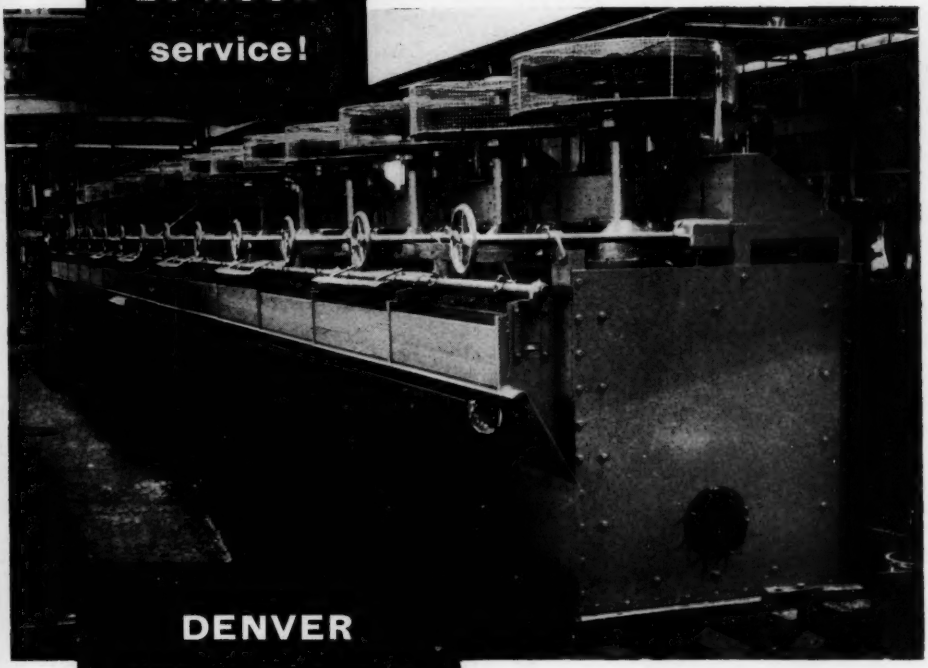

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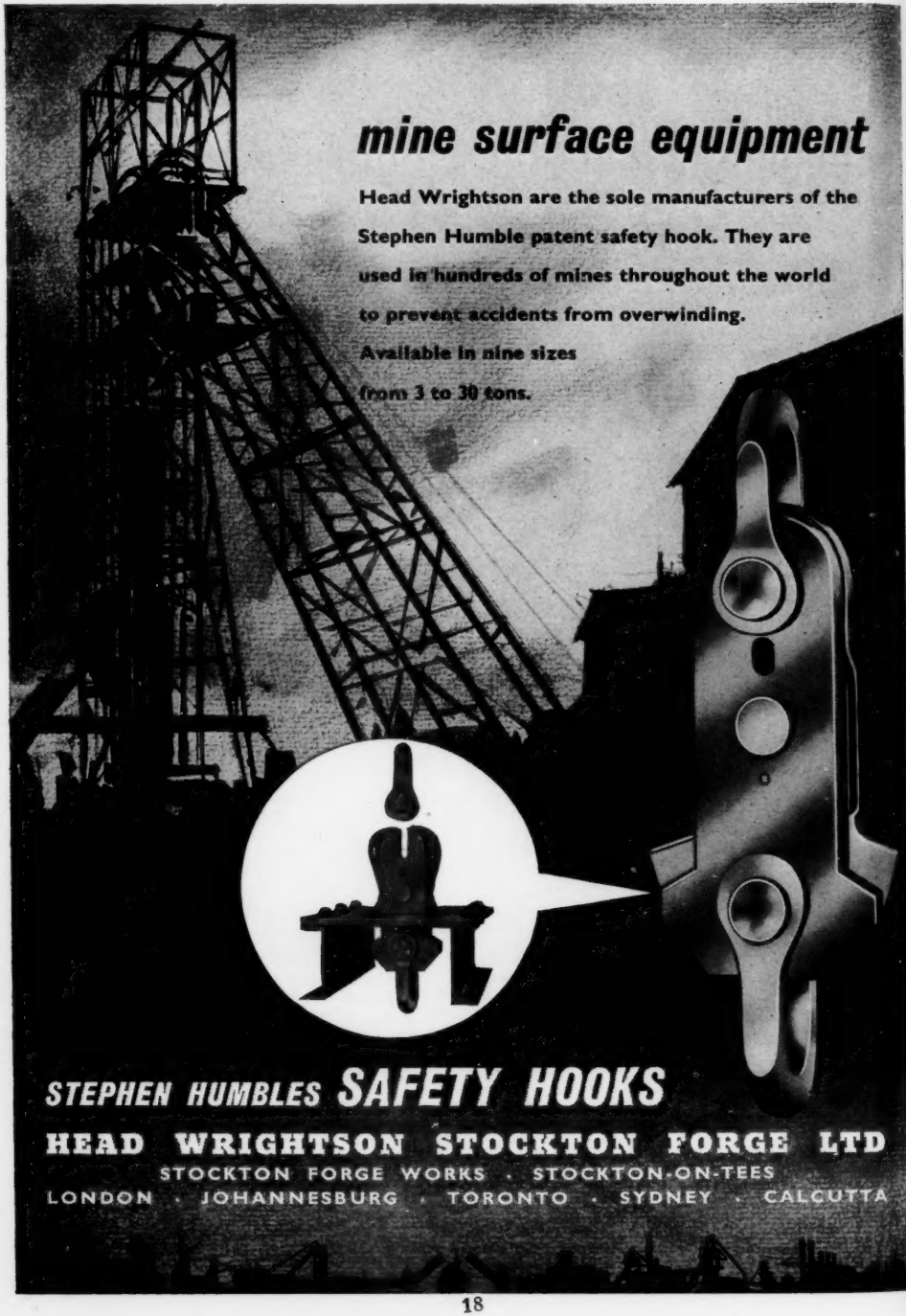
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Head Wrightson are the sole manufacturers of the Stephen Humble patent safety hook. They are used in hundreds of mines throughout the world to prevent accidents from overwinding.
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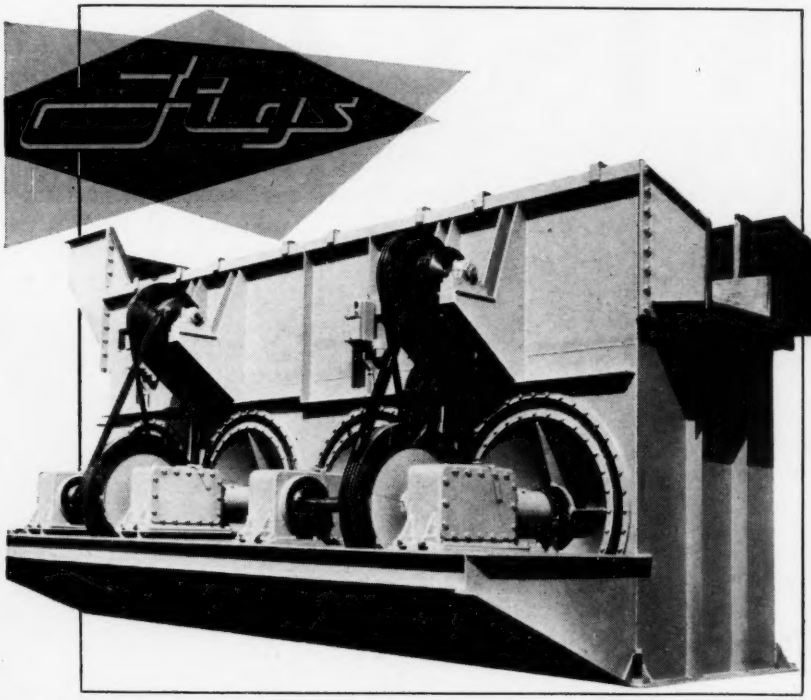

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Ever since they built their first mineral dredgers and ore separation plant the partners of I.H.C. Holland have given much thought to the problems connected with this subject.

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Those interested in such jigs are invited to write for a copy of a leaflet containing a more detailed description

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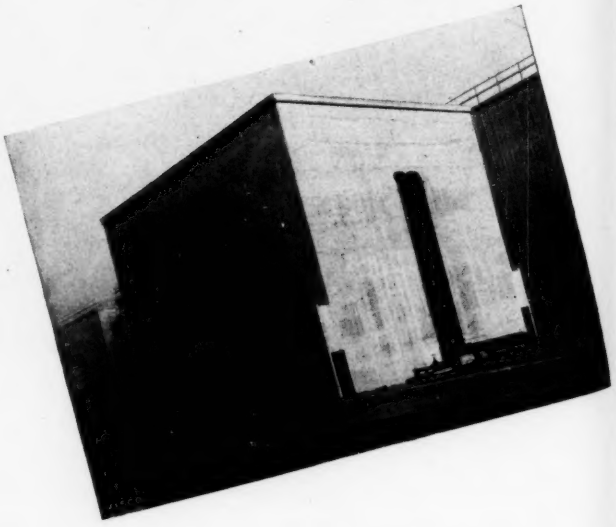

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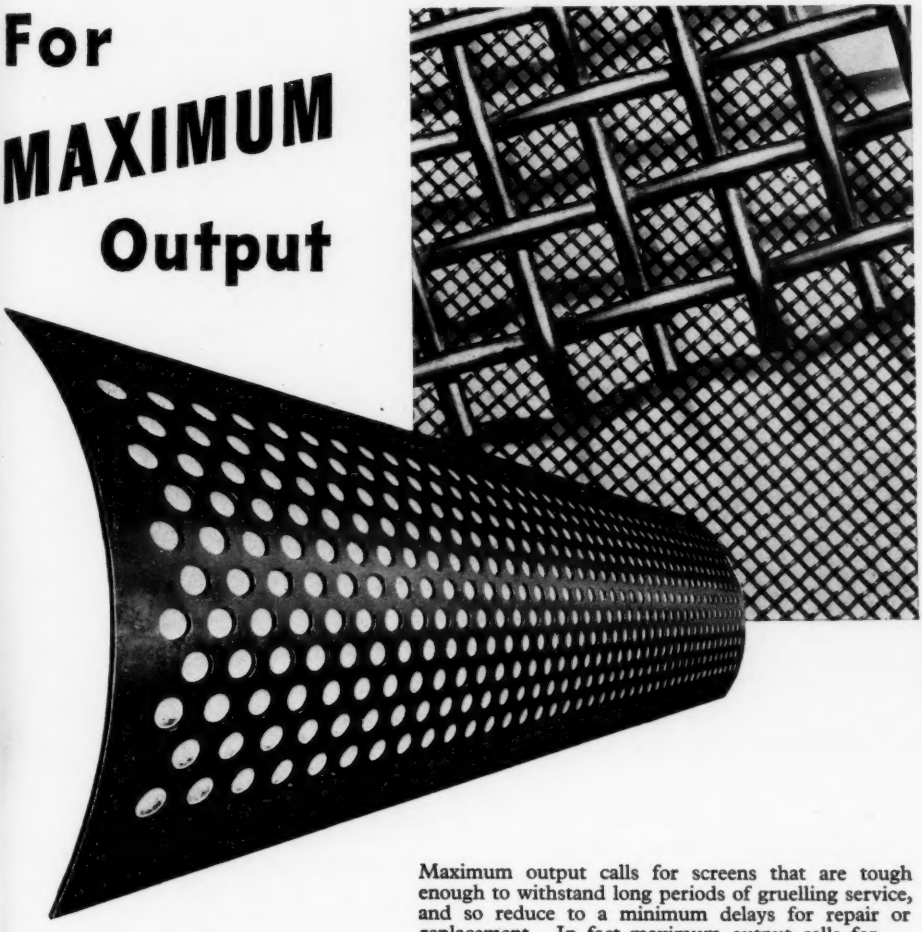

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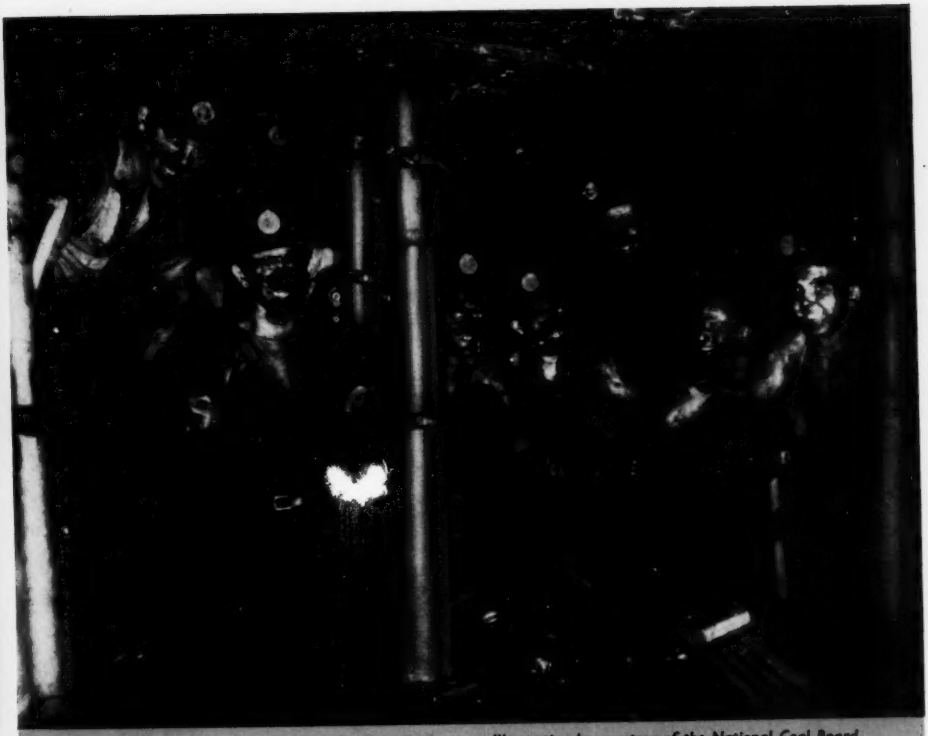

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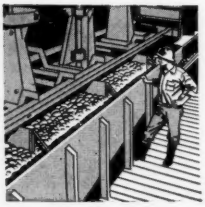

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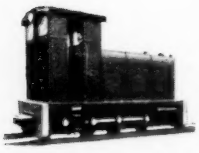
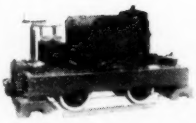
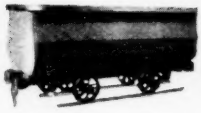

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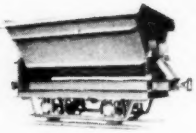

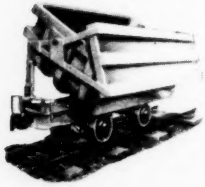
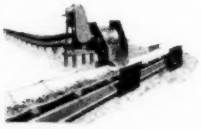

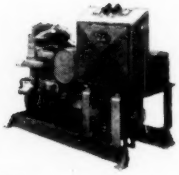

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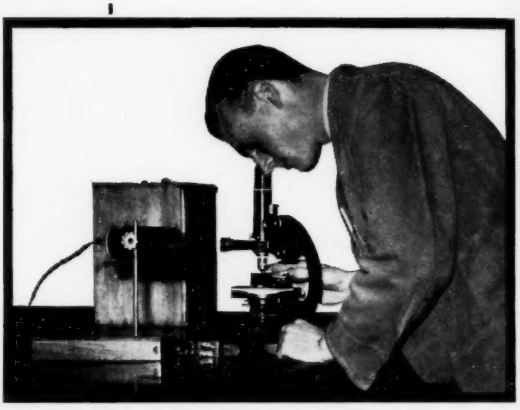

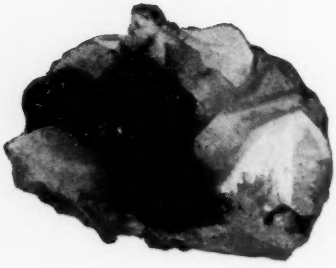

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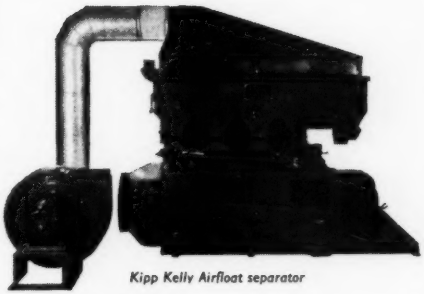

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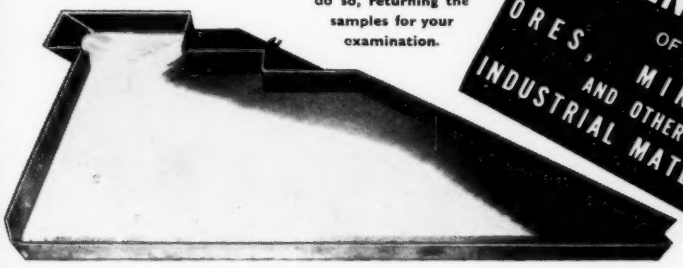

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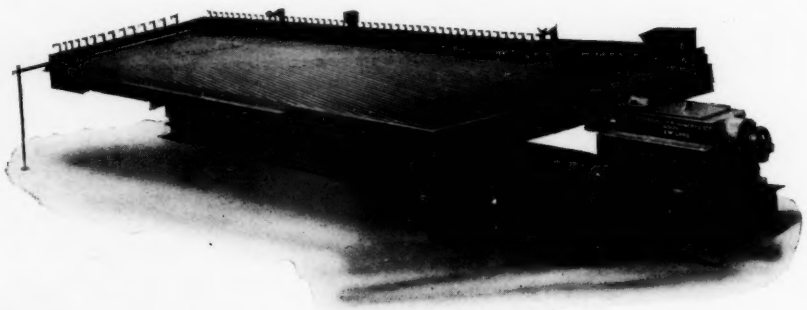

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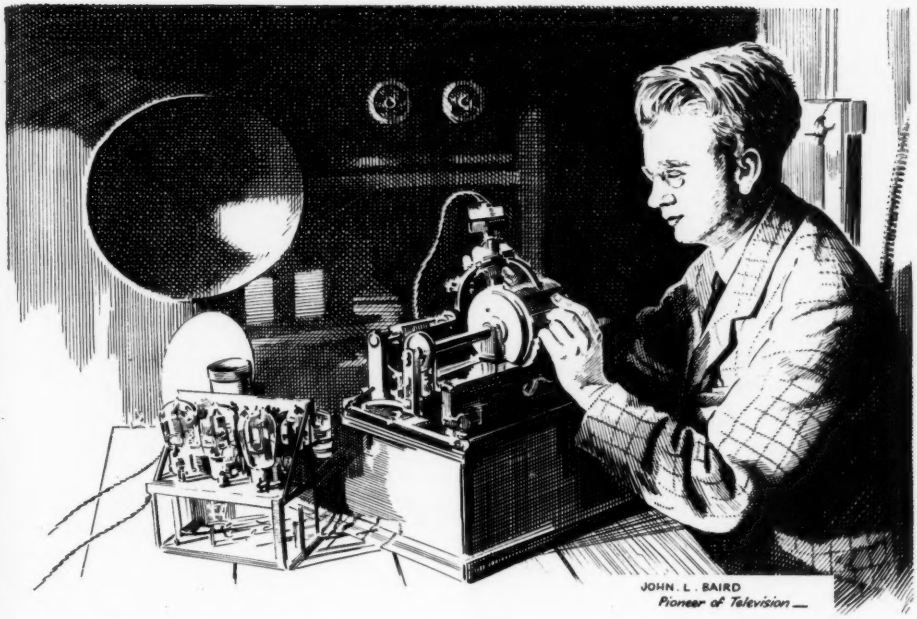
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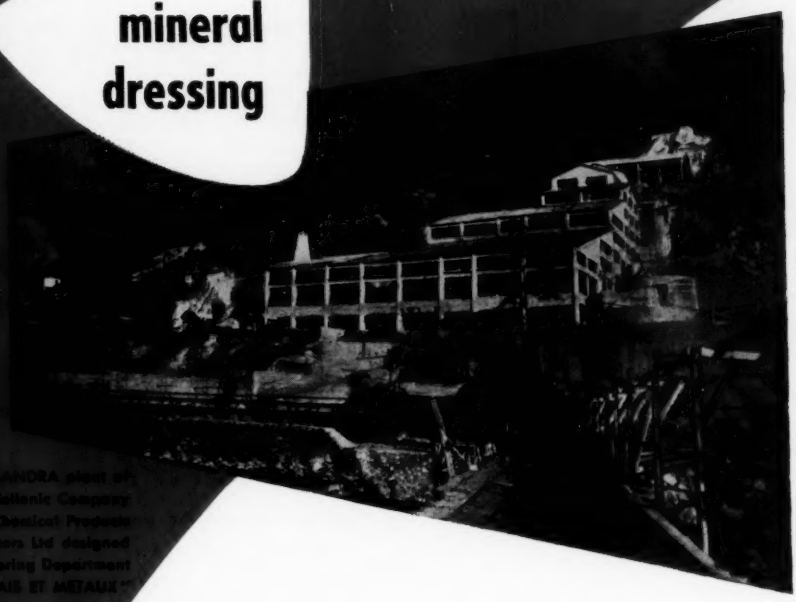

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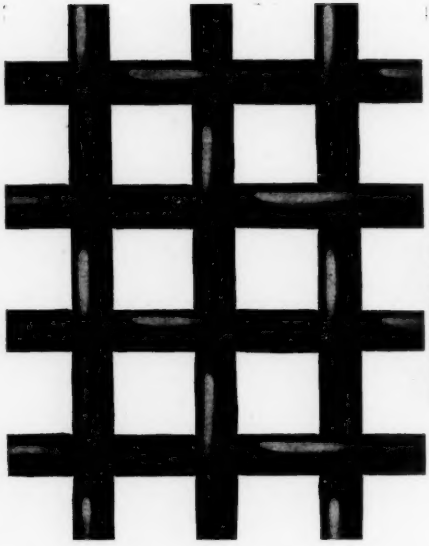

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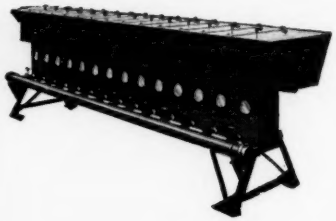

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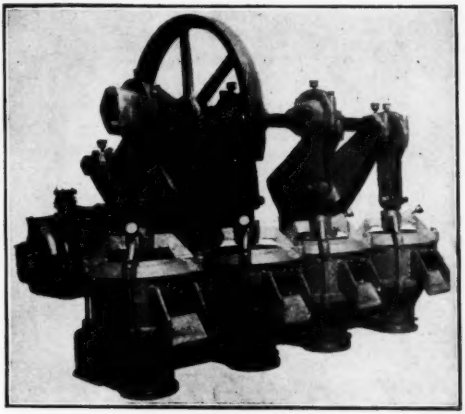

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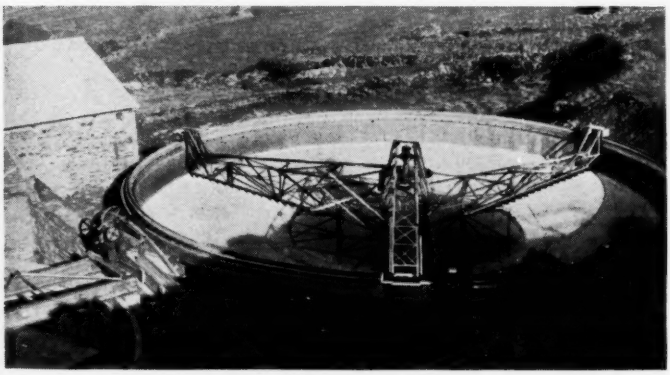

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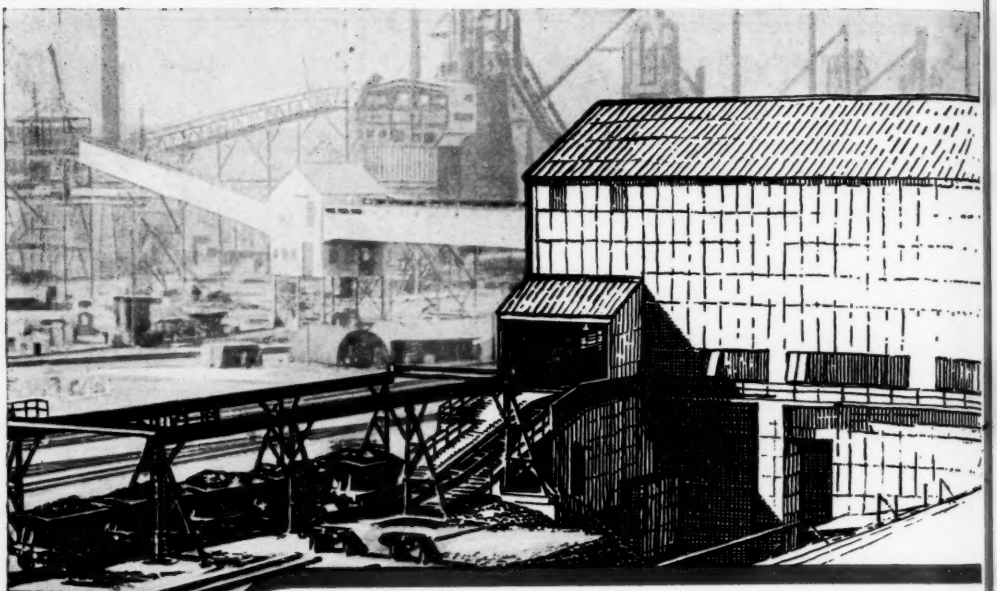

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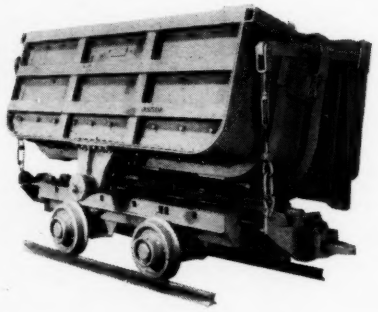

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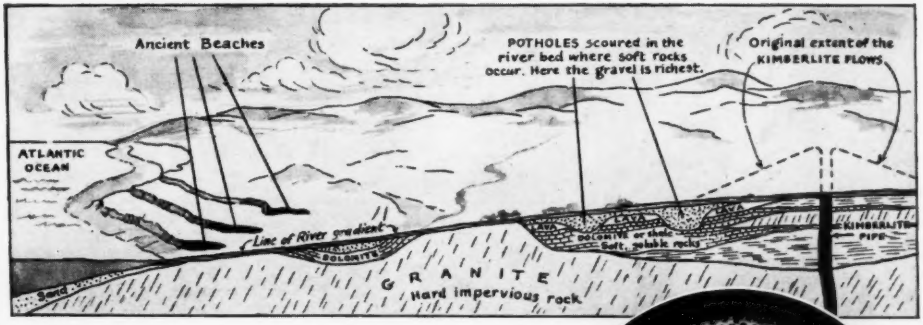
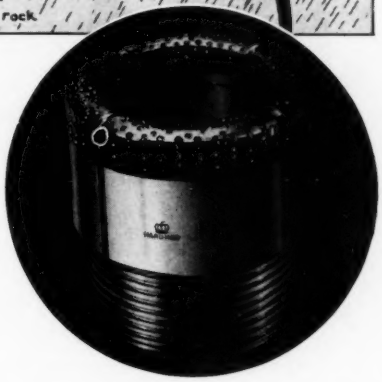


How diamonds reach rivers and the sea



If diamonds are of volcanic origin, how do they come to be found in river beds and on the sea shore? Alluvial deposits originally derived their diamonds from the upper portions of volcanic pipes and fissures. The upper portions of these were denuded of their diamonds by erosion through the ages.

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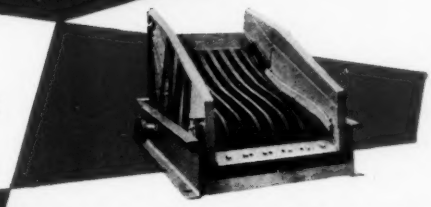

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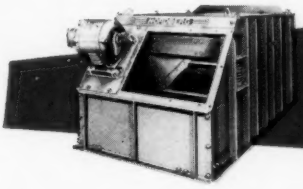

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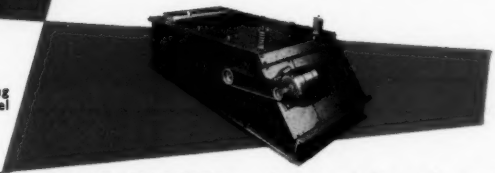

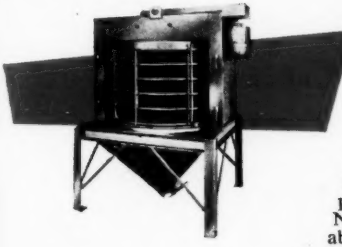

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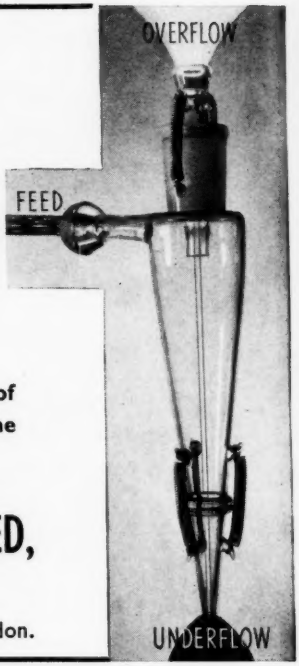

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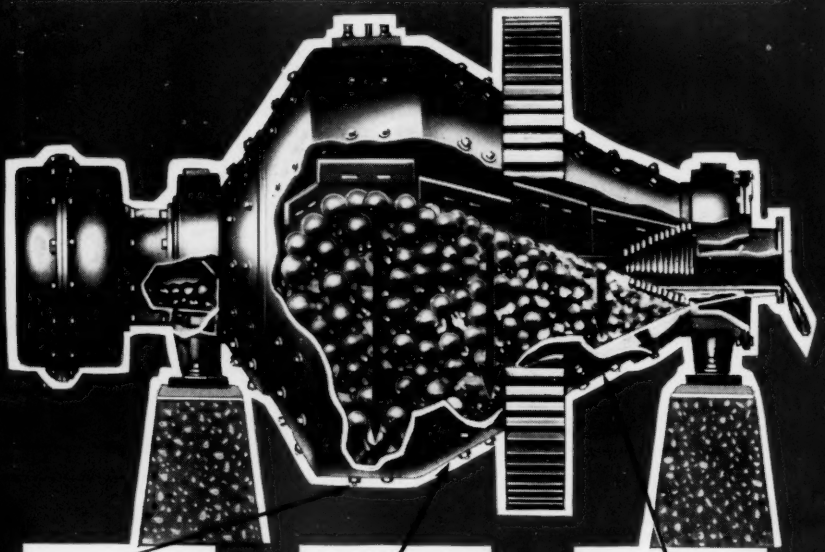

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COMPANY MEETINGS AND REPORTS SECTION

DE BEERS CONSOLIDATED MINES, LIMITED

(*Incorporated in the Union of South Africa*)

Gem Sales Satisfactory in View of U.S. Recession

GROUP'S ASSETS OUTSIDE DIAMOND INDUSTRY NOW £88 MILLION

The following are extracts from the statement by the Chairman, Mr. H. F. Oppenheimer, which has been circulated with the annual report and accounts :—

It has fallen to me to succeed my father as chairman of De Beers Consolidated Mines, Limited, and its subsidiary and associated companies. I am very grateful to my colleagues for the confidence they have shown in me and at the same time am deeply conscious of the great responsibility which is involved.

An essential factor for the stability of the diamond trade is the close co-operation that has long existed between the producers of our group and the important producers in the Belgian Congo, Angola, West Africa, and Tanganyika whose production has for many years been marketed with our own. I would like to express my appreciation of the friendly spirit in which these producers have recently reaffirmed their confidence in our organization.

To our great regret early this year Dr. J. T. Williamson, the discoverer of the diamond mine at Mwadui in Tanganyika territory, died. He was at once a figure of romance and a practical benefactor to Tanganyika. One could not fail to be impressed by his kindliness and his devotion to the interest of all who worked with him. Our sympathy goes out to his family and associates.

Gem Sales Encouraging

Gem sales for the year 1957 at £52,818,096 constituted a record for the third successive year. Towards the end of the year, however, there was a marked falling off in demand. In view of the current economic recession in the United States it was to be expected that the gem trade would weaken and the central selling organization, in accordance with its established policy in such circumstances, reduced the quantity of diamonds offered to the market. I am glad to report, however, that the results for the first quarter of 1958 are more encouraging. Sales of gem diamonds for these three months amounted to £10,513,699 as compared with £10,972,484 for the same period of last year, which in the circumstances must be regarded as very satisfactory.

Industrial sales for 1957 reached a satisfactory total of £23,954,016 but here again a serious falling-off in demand made itself felt towards the end of the year and this side of the business is still very weak. This is attributable not only to the business recession in the United States, but also to a considerable extent to the cessation of stockpiling purchases, with the exception of purchases of crushing boart, by the United States Government.

In his statement last year my father remarked that it was too early to predict where the remarkable achievement of the General Electric Company in producing synthetic industrial diamonds would lead. These synthetic diamonds consist of abrasive material which competes with the so-called crushing boart produced principally by the Société Miniere du Beceka at Bakwanga in the Belgian Congo. There is, so far as I am aware, no question of the synthetic production of the larger sizes and better qualities of industrials and the production of synthetic gem stones is apparently regarded as entirely impracticable.

Extensive tests are now being undertaken by our diamond research laboratory in Johannesburg to determine the properties of the new material and its advantages and disadvantages as compared with natural diamond for various uses and under varying conditions. The Société Miniere du Beceka has recently substantially increased its productive capacity and I would be surprised indeed if the synthetics could be produced as cheaply as the natural stones. However, in the past the chief limitation on the use of diamonds for abrasive purposes has been the shortage of supply and there may well prove to be room in the market both for the natural and the synthetic product.

Strong Financial Position

The financial position of the group has been strengthened still further during the past year. Large financial reserves are essential for the stability of the trade and under my father's chairmanship the financial strength of the company was carefully built up. At the end of the year the group's net cash assets totalled £26,959,607 in addition to which we held £9,496,532 in gilt-edged securities. When, in addition, the resources of the gem and industrial marketing companies, amounting to nearly £15,000,000 are taken into account, it will be clear that the group has ample financial resources for the protection of the trade.

As you are aware, our company has, in recent years through its subsidiary De Beers Investment Trust Limited, invested substantial sums in the Union of South Africa and the Federation of Rhodesia and Nyasaland outside the diamond industry. This policy was continued during the year and at the end of the year the value of the group's investment outside diamonds amounted to £52,345,826 in addition to the cash assets to which I have already referred.

We may look forward with confidence to increasing revenue from these outside investments and in making them we have broadened the base of the company's activities and added to its stability.

RAND MINES, LIMITED

(*Incorporated in the Union of South Africa*)

The sixty-third ordinary general meeting of shareholders was held in Johannesburg on May 30, 1958. The following is an extract from the circulated statement by the chairman, Mr. W. M. Frames, dated May 23, 1958 :—

Group Reorganization

You will have noted in the Annual Report the details of the changes that have been made in the Central Mining-Rand Mines Group organization and will probably recollect the Press announcement of August 13 last in this connexion. From September 1, 1957, Rand Mines has rendered executive, administrative, and technical services to the South African companies of the Group. The transfer to Rand Mines, Limited, of the Technical Departments previously under the administration of Central Mining Finance, Limited, in South Africa was effected smoothly.

Capital

Details are given in the directors' report of the recent issue of 700,000 reserve shares. The net proceeds of the issue amounted to £2,344,395. Of this amount £1,000,000 has been lent to Harmony Gold Mining Company, Limited, towards financing the expansion of that company's operations. Before the end of the year £250,000 had been advanced and the balance will be drawn by July 31, 1958. This loan is repayable in four half-yearly instalments of £250,000 commencing on June 30, 1960. Of the balance a portion has been used to increase investments in mining, financial, and industrial companies in South Africa and a substantial amount is held in liquid form and is available for employment in any proposition which offers promise of a favourable return.

Financial Results and Investments

The profit of £768,910 showed little change as compared with that of the previous year. After taking into account £427,504, being the balance of profit and loss account at December 31, 1956, £1,196,414 was available for appropriation. Dividends absorbed £723,411 and £40,000 was transferred to exploration reserve, leaving the balance of profit and loss account at £433,003 to be carried forward to 1958. Quoted investments were taken into account at cost less amounts written off but in no case above market value at December 31, 1957. Unquoted shares were valued at cost or at a conservative valuation, being less than cost, by the directors. Owing to a fall in the Stock Exchange value of some of the quoted securities and a revised valuation of some of the unquoted securities it was necessary to depreciate certain investments by a total amount of £308,634.

After allowing for this depreciation and the investment of net additional funds of over £500,000 the total book value of investments increased by £223,149 to £8,328,684. The market value of the company's quoted investments increased by £1,012,355 to £10,593,027. Of these quoted investments three-quarters are in gold and coal mines, 85% of which have a life expectation in excess of 20 years. The net cash surplus at the end of the year was £1,901,623, an increase of £1,515,658 over the previous year, resulting from the increase of capital towards the end of the year.

Associated Companies

Gold Mining.—Compared with the previous year the tonnage milled by the Witwatersrand and Orange Free State mines of the group in 1957 decreased by 1,284,036 tons to 15,961,396 tons, owing mainly to the cessation of milling by Modderfontein B Gold Mines, Limited, New Modderfontein Gold Mining Company, Limited, and Welgedacht Exploration Company, Limited, and the curtailment of operations by Crown Mines, Limited. Although the yield at 4·378 dwt. increased by 0·172 dwt. the total ounces fine recovered fell from 3,627,110 to 3,493,697. Working profits from gold at £10,277,500 were £407,409 less than the year before, while the profits from uranium increased by £680,347 to £2,967,008. Total dividends and repayments of capital increased from £5,051,801 to £5,490,676. Tax and lease consideration increased by £464,205 to £4,331,588 and uranium loan repayments including interest decreased by £4,950 to £919,254.

Development footage decreased by 75,677 ft. to 335,557 ft., the footage sampled at 154,290 ft. being 66,050 ft. less than the year before. Estimated available ore reserves decreased by 3,095,000 tons to 29,039,000 tons.

Coal Mining.—The demand for coal in the inland market continues to be greater than the supply owing to transport limitations and to a shortage of non-European employees. As I pointed out in my address last year, increased mechanization is being undertaken in some cases to offset the labour shortage. Dispatches of coal from both Witbank Colliery, Limited, and Van Dyks Drift Colliery decreased compared with the previous year. In the case of the former colliery this was due to a severe shortage of non-European labour at Wolvekrans, where additional mechanized equipment has been installed and more is to follow and, in the case of the latter, to a shortage of railway trucks. The group has now acquired a further colliery interest through the purchase by Welgedacht Exploration Company, Limited, of the Utrecht Colliery in Natal.

Industrial.—The demand for cement in the Union slackened off somewhat at the beginning of 1957, but since then has taken an upward turn. The additional plant being installed by the Pretoria Portland Cement Company, Limited, at its Slurry works will be completed during the current year. Increases in the cost of new equipment continue to bear heavily on the cement industry. So far, with the one exception referred to in the annual report, increases in the controlled selling prices of cement have been determined by the authorities solely on the considerations of profits per unit—a method which, of course, fails under the present circumstances to provide adequate compensation for the cost of replacements and extensions.

The demand for lime continued to increase, particularly so in respect of the requirements of the uranium industry.

Since the close of the last financial year of the Hume Pipe Company (S.A.), Limited, there has been a decline in the demand for the products of that company's factories situated at the Cape.

Directors

After the close of the financial year Brigadier R. S. G. Stokes and Mr. W. D. Wilson resigned their seats on the board and Mr. S. D. H. Pollen and Mr. W. Marshall Clark were appointed to the board to fill the vacancies. As shareholders will be aware Brigadier Stokes had been a director of the company since 1936 and on behalf of the board and the shareholders I should like to thank him particularly for the long and valuable services he rendered to the company.

As an item of Special Business you will be asked to pass a resolution amending the Articles of Association whereby the maximum number of directors permitted will be increased from 12 to 15. In the event of your passing this resolution Lord Baillieu and Mr. B. G. Twycross will, as announced on March 19, 1958, be asked to join the board.

AMALGAMATED BANKET AREAS, LTD.

The twenty-second annual general meeting of Amalgamated Banket Areas, Ltd., was held on May 28 in London.

Major-General W. W. Richards, C.B., C.B.E., M.C., chairman, presided. The following is an extract from his circulated statement :—

The profit of £35,730 for the year ended September 30, 1957, has been largely utilized to write off diamond drilling expenditure, £8,371, and provision for obsolete stores, £25,000.

It was not until the end of the year under review that mining operations resulted in satisfactory profits and I am happy to say the improvement has been well maintained ever since.

The results of the first six months of the current year's operations, October, 1957, to March, 1958, have improved our company's financial position very considerably.

Since the end of the year both tonnage and grade have shown most satisfactory increases. The mine is now producing monthly over 60,000 tons of ore averaging about 5·0 dwt. per ton.

Development has been stepped up considerably, totalling 26,792 ft., as compared with 17,323 ft. the previous year.

The total available ore reserves at September 30, 1957, were computed at 1,281,107 tons, of an average value of 5·487 dwt. per ton over a width of 39·13 in.

Technical Efficiency

Mr. C. J. Burns, a director, said :—

On the technical side every effort has been made to reduce costs and improve efficiency. For example, explosives which are consumed in considerable quantities have received the attention of your consultants and mine's staff. A careful study of this subject has resulted in increased efficiency in as much as since March, 1957, the explosive costs per total footage of development have resulted in a saving of £9,612 per annum and for mining of £29,665 per annum of total pay ore mined, a total saving of £39,277 a year. On the power side careful planning and spreading of the electrical load have resulted in very economical operation of the power plants throughout the year.

The report and accounts were adopted.

MINE ECONOMICS

By Professor S. J. TRUSCOTT, A.R.S.M., D.Sc., M.Inst.M.M.

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NEW BROKEN HILL CONSOLIDATED LTD.

Substantial Benefit from O.T.C. Status

Mr. L. B. Robinson on Need to Conserve Cash Resources

The twenty-second annual general meeting of New Broken Hill Consolidated Limited, will be held on June 24 at 37, Dover Street, London, W. 1.

The following is an extract from the circulated statement of the Chairman, Mr. L. B. Robinson :

In 1957 the output of ore and the lead grade in ore produced were both appreciably higher than in 1956. A reduction in the average cost per ton of ore of approximately 18%, compared with the previous year, was achieved and the tonnage of lead realized in 1957 was 57,617 tons, compared with 44,044 tons in 1956. Despite these achievements the mine trading balance for the year amounting to £1,904,035, showed a decrease of £418,369 compared with 1956, due to the severe fall in the prices of lead and zinc during the last eight months of the year. The profit before taxation amounted to £1,591,313, compared with £1,991,129 for 1956.

The company has obtained recognition as an Overseas Trade Corporation as from April 6, 1957, and derives a substantial benefit from the reduction in United Kingdom taxation. The provision for Australian and United Kingdom taxation on the profits for the year amounts to £534,217, compared with £1,116,600 for 1956. The result is a net profit for the year of £1,057,096, an increase of £182,567 on the figure for 1956. The change of status to that of an Overseas Trade Corporation as from April 6, 1957, has also released provisions made in previous years for U.K. taxation amounting to £750,000.

The amount available for distribution including the above provision for taxation no longer required and the balance of £339,635 brought forward from 1956 is £2,146,731. As indicated in the announcement of the interim dividend, the directors are recommending a final dividend of 3s. per share, making a total distribution of 5s. for the year, which is the same as for 1956. The total required for the interim and final dividends is £693,059.

The directors have given very careful consideration to the disposal of the large balance available for appropriation. The prices of lead and zinc have remained at very low levels throughout 1958 to date and the outlook shows little promise of an early improvement. Further, it has been necessary not only to budget for a reduced production of ore at which it will be difficult to maintain last year's level of cost, but also to transfer part of the labour force to additional development work entailing the use of further capital funds. These factors will all mean a considerable drain during 1958 on the company's cash balances and the directors consider that it is essential to conserve resources to the utmost. Accordingly, the directors have not felt able to recommend a larger total distribution than 5s. per share for the year and have transferred £750,000 to general reserve and £350,000 to a mine amortization reserve.

Production

Ore production from the Company's leases in 1957 reached the record figure of 722,722 tons, compared with 606,325 tons in 1956, an average of 3,062 tons of crude ore per day as against 2,516 tons per day for 1956. This increase is attributable to increased efficiency and larger tonnages from sub-level stoping.

The operating efficiencies, measured by the output in tons per mining-department-employee-shift at 5·58 in 1957, showed a substantial rise on the figure of 4·37 achieved in 1956. The output per contract-stoping-miner-shift (excluding the sub-level stope on No. 16 level) showed an increase to 18·18, as against 16·54 in 1956. The output from the sub-level stope in 1957, reached the figure of 55·78 tons per contract-stoping-miner-shift, compared with 36·68 tons in 1956.

In 1957 721,241 tons of ore were treated for a production of 64,794 tons of lead, 1,704,892 oz. of silver, and 154,325 tons of zinc concentrate, compared with 47,950 tons of lead, 1,206,308 oz. of silver, and 137,990 tons of zinc concentrate in 1956.

Ore Reserves

In the Chairman's statement dated May 12, 1952, reference was made to the difficulty in separating ore reserves between the lead and zinc lodes. With the further information now available from development, it is considered that a clearer picture of the grades of ore reserves will be given if the present basis is changed to that of reporting ore reserves in terms of lead and zinc lodes.

Accordingly ore reserves at December 31, 1957, may be expressed on this amended basis as follows :—

	Tons Assaying	Lead %	Silver oz.	Zinc %
Lead lodes :	2,400,000	12·9	3·3	12·0
Zinc lodes :	900,000	4·9	1·2	13·7
Total :	3,300,000	10·7	2·7	12·5

The total at December 31, 1956, was 3,200,000 tons assaying 10·7% lead, 2·7 oz. silver, and 10·7% zinc.

At present metal prices portions of the lower-grade section of the reserves could not be extracted profitably.

The major items of underground development and drilling were as follows :—

1. Upward extension of No. 2 ore pass system from No. 16 to No. 13 level to permit zinc lode ore from the higher levels to be delivered directly to the underground crusher station.
2. Work on No. 2 airway extension was commenced on Nos. 16, 17, and 18 levels.
3. The testing of the lead lode structure at depth has continued as outlined in my statement last year.

In the upper zinc lodes further testing on Nos. 10 to 16 levels by drilling has been carried out, but further development work for the layout of stoping blocks has been postponed while the prices of lead and zinc are depressed to present levels. Exploration southwards, however, was continued from the south drives on Nos. 12 and 14 levels.

Outlook

The immediate outlook is of necessity overshadowed by the statistical position of base metals and in common with other producers our earnings are bound to reflect the current level of prices for lead and zinc.

CONSOLIDATED ZINC CORPORATION LTD.

Reduction in Trading Profits

Decline Offset by Lower Mining Royalty and Taxation

The ninth annual general meeting of The Consolidated Zinc Corporation Limited, will be held on June 24 at 37, Dover Street, London, W. 1.

The following is an extract from the circulated statement of the Chairman, Mr. L. B. Robinson :

The severe fall in the prices of lead and zinc during the last eight months of the year caused a substantial reduction in the trading profits for 1957.

The Zinc Corporation Limited again increased ore production and achieved a lower cost per ton of ore at Broken Hill than for the previous year. Nevertheless, the reduced average prices realized for lead and zinc concentrates resulted in a much lower profit than in 1956.

Consolidated Zinc Proprietary Limited had a satisfactory year and showed a considerably increased profit.

Imperial Smelting Corporation Limited had a lower output of zinc but deliveries of alloys were considerably greater than in 1956. Profit margins on most products were reduced and overall the profits from trading for the year in the United Kingdom were somewhat less than in 1956.

Income from trade investments at £941,688 showed an increase mainly due to higher dividends from New Broken Hill Consolidated Limited and British Titan Products Company Limited. Interest on Government securities and other interest and miscellaneous income at £325,135 was also higher than in 1956.

The consolidated profit of the group, before mining royalty and taxation, amounted to £4,322,442, compared with £6,123,432 for 1956.

Due to the considerably reduced charge for royalty and taxation the consolidated net profit for the year, at £1,769,986, was ouly £274,397 lower than the net profit for 1956.

Proposed final dividend of 2s. 6d. per share, compared with 3s. last year, giving a total of 3s. 9d. compared with 4s. 6d. last year.

In the prevailing conditions of world markets in which, in common with many other commodities, a surplus of lead and zinc has developed, both the Zinc Corporation and New Broken Hill Consolidated have budgeted for a reduced production of ore and recoverable metals during the current year.

Zinc Smelting

The operation of the Imperial Smelting process on the Avonmouth site made further satisfactory progress during the year.

A decision has recently been taken to replace the horizontal retort zinc distillation plant at our Swansea Vale works with the installation of an Imperial Smelting process plant.

Bauxite

Commonwealth Aluminium Corporation Pty. Limited, in which the British Aluminium Company Limited will be associated with us, has during the year made substantial progress in its investigation and planning for the development of the bauxite deposits at Weipa on the west coast of Cape York peninsula.

In December a comprehensive agreement was negotiated with the State of Queensland providing for the development of the field. A feature of the agreement is Commonwealth Aluminium Corporation's undertaking to establish an alumina plant in Queensland as soon as practicable after the company has completed its investigations.

Canada

In Canada our subsidiary, Consolidated Zinc Corporation of Canada Limited has continued to be active in the search for minerals both in association with Yukon Consolidated Gold Corporation Limited and with others. As a result of negotiations concluded towards the end of the year we have acquired a shareholding in Siscoe Mines, Limited, and assumed the management of that company.

Research and Development

The research and development departments have carried out a vigorous programme investigating means of improving the efficiency of existing processes and seeking new outlets for our products. In addition examination has been made of a number of new processes and materials in the continued search for opportunities of widening the base of our activities.

Lead and Zinc Markets

Since I last reviewed the lead–zinc situation there have been important changes in the world economic scene and the main brunt of a reversal of the inflationary movement has fallen on international commodities. Last year I also referred to the problems that would emerge with a change in U.S. stock-piling policy. This change came about all too soon thereafter, with the added threat, now embodied in recommendations from the U.S. Tariff Commission, of increased duties or even quotas on imports into that market. Additionally the situation has become still more confused by the publication of the U.S. Government's own plan to subsidize domestic production at guaranteed price levels for fixed tonnages.

During the same twelve-month period we have also suffered from a continuing liquidation of stocks in the United Kingdom held by the Board of Trade, although I am pleased to say that, temporarily at least, sales of zinc from that source have been suspended.

All these factors have had a severe effect on prices and since May of last year lead and zinc have suffered a loss on the London Metal Exchange of approximately 40%. Unfortunately the prospects for improvement in the present position of oversupply of these metals are further obscured by the uncertainties of the general condition of trade throughout the world and in particular by the steps being taken or proposed in various countries, notably the U.S.A., for the protection and even expansion of domestic production. In these circumstances it is difficult if not impossible to forecast an early improvement in prices but it is, I believe, quite clear that a higher level will be essential to sustain the production of these metals

necessary to meet the continued progress towards a higher standard of living throughout the world.

Shareholders will remember that on previous occasions we have suggested that a combined lead–zinc price in the United Kingdom of around £175 would prove satisfactory for both producers and consumers. This figure is, I would emphasize, some way below the level which the U.S. Government during its stockpiling programme considered not only reasonable but worthy of support and I still believe that a combined price of £175 will in the long run be required to meet the needs of world markets.

The Outlook

In the current year our earnings must be seriously affected by the present low level of prices. However, in spite of the unfavourable features in the immediate outlook for commodity prices and in the statistical position of the metals which at present provide our main source of income, we remain confident that the world will continue to progress to higher standards of living and that not only demand will increase, but that the prices of the metals in which we are interested will in time return to more remunerative levels. Meanwhile we consider the projects in hand to improve the efficiency and economic return from our existing operations are essential, even though the timing and rate of progress of these projects must necessarily be governed by our financial resources.

NEW CONSOLIDATED GOLD FIELDS GROUP OF COMPANIES

DECLARATION OF DIVIDENDS

NOTICE IS HEREBY GIVEN that the following dividends have been declared, payable to shareholders registered in the books of the undermentioned Companies at the close of business on 30th June, 1958, and in the case of The Sub Nigel Limited to those persons presenting Coupon No. 93 detached from Share Warrants.

The dividends have been declared in the currency of the Union of South Africa and will become due on 1st July, 1958. Dividends payable from the London Office will be paid in United Kingdom Sterling currency at par provided that should there by any difference that may be regarded by the Boards as material in the exchange value of the South African and United Kingdom Sterling currencies on 1st July, 1958, the said Office will pay at the rate of exchange ruling on that date. Persons presenting Coupons will be paid in United Kingdom Sterling currency calculated on the above basis on 1st July, 1958, irrespective of the date of presentation of the Coupons.

Dividend Warrants will be posted on or about 7th August, 1958, from either the Head Office or the London Office to shareholders at their registered addresses or in accordance with written instructions received and accepted by the Companies concerned on or before 30th June, 1958. All such warrants in respect of payments to be made to persons with addresses in Africa south of the Equator will be posted from the Head Office and all other such warrants will be posted from the London Office.

Dividend Warrants despatched from the London Office to persons resident in Great Britain or Northern Ireland will be subject to a deduction of United Kingdom Income Tax at rates to be arrived at after allowing for relief (if any) in respect of Dominion Taxes.

In the case of The Sub Nigel Limited the dividend on shares included in Share Warrants will be paid in London or in Paris in terms of a notice to be published later by the London Secretary of that Company.

Non-Resident Shareholders' Tax of 7½ per cent will be deducted from dividends, where applicable, and from all Share Warrant Coupons presented for encashment.

The Transfer Books and Register of Members will be closed in each case from 1st to 5th July, 1958, both days inclusive.

Name of Company (each incorporated in the Union of South Africa)	Dividend No.	Coupon No.	Rate of Dividend Amount, per Share
Doornfontein Gold Mining Company Limited	3	—	1s. per 10s. share.
Libanon Gold Mining Company Limited	15	—	3½d. per 10s. share.
The Sub Nigel Limited	91	93	1s. 6d. per 10s. share.
Venterspost Gold Mining Company Limited	37	—	10½d. per 10s. share.
Vlakfontein Gold Mining Company Limited	30	—	11d. per 10s. share.
Vogelstruisbult Gold Mining Areas Limited	39	—	1s. per 10s. share.
West Driefontein Gold Mining Company Limited	11	—	3s. 9d. per 10s. share.
West Witwatersrand Areas Limited	19	—	1s. 7½d. per 2s. 6d. share.

NOTES. 1. RIETFONTEIN CONSOLIDATED MINES LIMITED.
ROBINSON DEEP LIMITED.
SIMMER AND JACK MINES, LIMITED.
No dividend declarations have been made by these Companies as it is proposed to make returns of capital to Members in lieu thereof.
Separate announcements in this connection appear adjacent to this Notice (pp. 59–60).

2. THE LUIPAARDS VLEI ESTATE AND GOLD MINING COMPANY LIMITED.
The dividend announcement of this Company appears in a separate notice.

By Order of the Boards,

G. H. WARD,
London Secretary.
10th June, 1958.

London Office: 49, Moorgate, E.C. 2.

THARSIS SULPHUR AND COPPER CO., LTD.

Directors : W. P. Rutherford (*Chairman and Managing*), Lord Glenconner, H. Hogarth, Neil Rutherford, Iain Rutherford, Antoine Velge, James C. Robertson, Robert P. A. Fossorier. *Secretary :* William Johnston. *Office :* 136, West George Street, Glasgow. *Formed :* 1866. *Capital :* £1,250,000, in £2 shares. *Business :* Operates mines in the Huelva district, Spain.

Mr. W. P. Rutherford's Review

The annual general meeting of the Tharsis Sulphur and Copper Co., Ltd., was held on May 14 at the registered office of the company, 136, West George Street, Glasgow, C. 2.

Mr. W. P. Rutherford, chairman of the company, who presided at the meeting, said : I propose, if you agree, to take the report and accounts as read.

Mines

In all departments during last year work at our mines in Spain was carried out satisfactorily. Mining operations were on a reduced scale compared with the previous year due to lesser exports and to reduce the large accumulated stocks at our port. Surplus labour is usefully employed in preparatory work and at the Centre Lode scheme. At North Lode we have installed the major items of plant and all the buildings are completed with the exception of the mineral storage deposit which is still under construction. A small amount of pyrites has already been drawn from this Opencast for our cupreous pyrites shipments. As the western limits of this ore-body lie close to our Sierra Bullones Mine, we are driving an underground connecting road which will allow us to explore the North Lode at depth and eventually handle the output of both mines in our new plant.

You will be pleased to know that after careful investigation of Centre Lode on the 3rd floor and by drilling from the surface, we have started mining operations there. The scheme is for a small Opencast for which mining costs will be favourable. Investigations at a lower level continue and the mining scheme is capable of extension should the cupreous ore persist. At our two main producing mines, Calanas and Sierra Bullones, output has been reduced, as I have already explained. Good results have been gained from tests of the latest blasting technique, which has increased the fragmentation of our very hard pyrites.

As you know, for the last 23 years we have operated at South Lode a small cyanide mill for the extraction of gold and silver from gossans. It has been rewarding from the start. The reserves in South Lode are not large but we are now also treating gossans from the old overburden dumps at Centre Lode which are amenable to cyanide treatment and will prolong this small successful enterprise.

At Corrales, close to our shipping piers, modifications to the crushing plant are designed to meet the special requirements of some of our customers for more finely crushed pyrites. We have also had to provide a new covered storage deposit to cope with special classes of pyrites and we are greatly enlarging the transporter deposit at Corrales to accommodate the different classes and sizes of mineral. Our intention is to export old stocks of calcined residues lying at the mines and for this also the increased stocking capacity is essential. The railway is now completely relaid with 70 lb. and 90 lb. rails, and has operated smoothly throughout the year. The oil-fired locomotives have shown a considerable reduction in operating costs and tests continue on our new experimental train of 42 ton ore-cars.

Accounts

Turning to the accounts, as you have seen, they show a position similar to 1956. The sums spent on capital additions over the last few years have been unusually high but our mining properties, railways, and port could not be satisfactorily maintained in the war years. After the end of the war the long delays in obtaining new equipment and the difficulties of export and import licences further delayed the rehabilitation programme. The fact that this major work is now almost completed entirely from our own resources reflects the strength of the company. For several years Spanish tax on profits and dividends has been a heavy charge against the company's profits but, as you already know, we have received considerable allowances for such payments in the form of Unilateral Relief against our British tax liabilities. You will observe that there is a greatly reduced debit in the accounts. This is partly due to a settlement with the Inland Revenue in respect of certain prior years, together with substantial tax allowances on the plant and machinery installed during the year. Consideration is still being given by the Inland Revenue as to the company's qualification as an Overseas Trade Corporation. Whatever the ultimate decision may be the effect will not be of fundamental importance and with increasing taxation in Spain we can even envisage that it might be to our advantage to be excluded.

Pyrites Market

The pyrites trade is not as active as we should like, especially in view of our production capacity. There are too many imponderables in world trade to venture on predictions but we go forward with calm confidence in the knowledge that we have a first class property and an installation that is modern and efficient. On the other hand pyrites producers have deemed it necessary to lower their export sales prices and since 1956 these reductions amount to 22% ; this is a trend in line with that of most primary materials. I feel that I must say a word on our market position. The Spanish chemical trade is our largest buyer and the price of pyrites delivered in Spain is controlled at a level which does not cover all costs. By increasing the controlled price to a profitable level the Authorities can place the mines in an improved competitive position and add protection to this important National industry.

As you know, the main components of pyrites are sulphur and iron and these are associated with smaller percentages of copper and other non-ferrous metals. The initial sale of our mineral is made on a basis of its sulphur content and must, therefore, be competitive with elemental sulphur coming from the U.S.A. and Mexico and now from natural gas being produced at Lacq in South-West France. After the extraction of the sulphur a high content iron ore remains together with the associated metals and this constitutes an important rebate to the buyer, so that, should the price of sulphur be reduced we would be less severely affected than producers of elemental sulphur. The rate of exchange is also an important factor in our price fixing, so that Spain can, by adjustment of the exchange rate for pyrites, afford protection for this very important industry. Apart from our normal crude pyrites, mineral containing 1% and over of copper is marketed as cupreous pyrites and shipped to Western Germany. The residue is treated by the Duisburger Kupferhütte and our portion of the copper extracted is returned by us to Spain as electrolytic copper. This is beneficial to Spain and provides us with an extra source of revenue so that our present mining programme is aimed at maintaining or increasing our output of cupreous pyrites.

Before concluding my remarks on the market and its prospects it is not amiss to remind you that sulphur is an essential of the chemical industry on which industrial progress so much depends. It is interesting to recollect that Benjamin Disraeli, with remarkable vision, is reputed to have said that sulphuric acid is the life-blood of a nation. At that time the United Kingdom annual production of sulphuric acid was about 800,000 tons; it is now 2⅓ million tons. With the advance of backward countries the increase of world population and the universal desire for higher living standards, it cannot be doubted that demand will contine to increase. But at present the potential production of sulphur, whether in elemental form, in pyrites or from natural gas, is greater than the demand. Looking ahead, therefore, it would appear that a gradual readjustment of European markets by transatlantic sulphur producers will be necessary.

Directors

Our director, Monsieur Lemaignen, resigned on being appointed by his government to the European Economic Commission which precludes him from holding other appointments. In his place we have co-opted his colleague in the Société Commerciale d'Affèrtements et de Commission, Monsieur R. Fossorier, vice-president of said company. Due to frequent absence of our working directors attending to our Continental business, we consider it necessary to have an additional director available in Glasgow. In consequence, we have co-opted Mr. James C. Robertson, director of Messrs. William Robertson, Shipowners. Both are experienced in business and will be helpful on our deliberations. They will be proposed for election presently.

Before concluding my address, I desire to express our praise to our staff in Spain and the arduous work of Mr. Mackenzie, our General Manager and also of our staff here, who excellently serve us.

I now propose that the Directors' Report and Statement of Accounts for the year ended December 31, 1957, be and are hereby approved and adopted and that a dividend of 12½% on the capital of the company be now declared, payable, less income tax, on and after May 21, 1958.

The report and accounts were unanimously adopted, the retiring directors, Mr. Hugh Hogarth, Mr. Neil Rutherford, Mr. James C. Robertson, and M. Robert P. A. Fossorier, were re-elected, and the remuneration of the auditor, Mr. Hugh Cowan-Douglas, C.A., was fixed.

The proceedings terminated with a very cordial vote of thanks to the chairman, proposed by Mr. William C. Campbell.

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MINERALS SEPARATION, LIMITED

Another Profit Record Established

Proposed Increase of Capital

Mr. J. N. Buchanan's Statement

The fifty-third annual general meeting of Minerals Separation, Ltd., will be held on June 25 at the offices of the company, No. 82, King William Street, London, E.C.

The following is the statement by Mr. J. N. Buchanan, the chairman, which has been circulated with the report and accounts for the year ended December 31, 1957.

Colonel A. C. Howard, D.S.O., M.C., retires from the board this year by rotation and does not seek re-election. He first joined the company in 1908 and was managing director for the years 1924 to 1951, when he retired from the executive on pension. During his long service to the company he saw many changes in our activities ; in earlier days he was most active in the exploitation of the company's processes in many parts of the world on which a great part of the company's present prosperity was hriginally built. He will be gratefully remembered oy us all and we wish him continued health and bappiness in his retirement.

At this meeting we propose the election to the board of our secretary, Mr. C. J. Dorman. In the last few years owing to the growth of our subsidiaries and other investments the responsibility falling on his shoulders has increased greatly. He has met this challenge with an ease and efficiency that command our grateful respect. We are confident you will endorse our proposal with a warm welcome.

The past year has seen another record established in our profits. As appears in the consolidated profit and loss account, the group gross profits rose from £693,000 to £740,000 and the net, after tax, from £305,000 to £342,000. While the results of the Foundry Services Group showed little change from that of 1956, the figures of both Jackmans and Howard Potteries showed considerable improvement. As was to be expected, our income from other investments was down, but by less than we expected having regard to the substantial fall in dividends received from our Rhodesian investments.

During the year we sold a substantial amount of our investments with the result that our cash at the end of the year showed a considerable increase. The higher rates obtainable on short-term deposits during the closing months of last year and earlier months of the current year relieved us of any immediate pressure to re-invest our funds, giving us a welcome liberty of action.

New Acquisitions

Since the turn of the year we have acquired control of Angel Hill Investments, Ltd., a private company which holds all the capital of Modern Engineering (Bristol), Ltd., and A.T.A. Industrial Co., Ltd. These companies offer a wide service in the planning, design, fabrication, and erection of modern industrial buildings, both in steel and concrete. In addition the licence is held for the construction of the well-known Silberkuhl composite steel and concrete roofs, a number of which have been built or are under construction in this country. These roofs are of exceptional strength and provide clear spans ranging from 80 ft. to 210 ft.

We have other opportunities for investment under consideration. To meet these and other expenditure, such, for instance, as the continuing expansion overseas of Foundry Services, we proposed to raise £250,000 by an issue of £100,000 nominal Ordinary stock (400,000 5s. units) ranking in all respects *pari passu* with the existing capital of the company. This issue will be available to existing shareholders in the proportion of one new unit at 12s. 6d. per unit for every 10 units held. Consent has been obtained from the Capital Issues Committee. A resolution for increasing the authorized capital will be submitted at the annual general meeting and the documents will be issued as soon as the necessary formalities have been completed.

Progress Reviewed

Over the past few years, as our accounts have shown, we have realized considerable capital gains from the sale of some of our investments. The Taxation Authorities have from time to time made inquiries into these transactions and full information has always been supplied to them. No definite action had, however, been taken by them until in April this year assessments in respect of these gains for the years 1954, 1955, and 1956 were made upon the company. Confident as we were and are of the strength of our case, we were faced with—at the best—a long delay involving expense and risk of litigation before we could hope to establish our right to exemption from such tax. We therefore deemed it prudent to offer to compromise by agreeing, without prejudice to our future position, that the company should pay tax on the balance of gain and loss on certain agreed transactions on which there was some risk that we might be held liable to tax. Our offer has been accepted in principle by the authorities and it now remains for detailed figures to be worked out to ascertain the amount for which the company is liable. Our calculations indicate that if 1957 be included with the three preceding years the resulting liability to tax need cause shareholders no serious concern.

As explained last year, the dividends we received from our Rhodesian holdings in 1956 were exceptional and, as expected, were not repeated in 1957. In the current year we must again expect lower dividends than last year. We have a long experience of copper and know that it is a commodity which has always indulged in extremes of price, both up and down. We know enough never to attempt to forecast the near future trend of the metal. Nevertheless, as our history shows convincingly, an investment in well-managed copper enterprises such as we hold has been in the past most remunerative and we are confident that in the future we shall not regret retaining a substantial holding in

Rhodesia. This holding represents, on the basis of present market values, less than 10% of our total investments.

Expanding Oversea Interests

Over all, this group's profits were maintained in the more difficult trading conditions of 1957 at about the same level as for 1956. The United Kingdom turnover and profit increased. A further major extension has been made to the Drayton Manor factory to cater for the expanding market, especially in the steel industry. Due to the increasing activity of our manufacturing companies abroad there was a reduction in the volume of goods exported from this country. All overseas interests and activities are still expanding. Royalty income was maintained but over all there was some reduction in the profits of the overseas subsidiaries. This was mainly due to the decision to enlarge our facilities and increase our staff with the definite purpose of achieving steadily increasing returns in the future. This particularly applies to the United States, where Mr. Dave Morgenthaler has been appointed president and with the active co-operation of our partners, Messrs. J. H. Whitney and Co., the re-organization is being planned on a footing which should enable it successfully to develop the great potential for our products there. Plans are well forward to transfer our activities from Columbus, Ohio, to Cleveland, Ohio, where a new and larger factory of suitable design to meet our specific requirements will shortly be erected.

In Canada results were satisfactory in spite of the reduced industrial activity. In Europe all the four operating companies made profits. In South Africa both turnover and profits were increased. The associated Japanese company consolidated its position and had a successful first year.

Since the turn of the year new companies have been formed in India, Switzerland, and Australia. In India we are working in close association with Messrs. Greaves Cotton and Co., Ltd., of Bombay, who formerly acted as our agents.

Increased attention is being given to research and development both to ensure an ever-expanding market for the group and to strengthen the leading position in this field.

J. W. Jackman and Co., Ltd.

J. W. Jackman and Co., Ltd., had an exceptionally good year. The large automatic moulding machines built by Jackmans at Manchester to the designs of the Osborn Manufacturing Co., Cleveland, Ohio, U.S.A., were completed and put into successful operation at the new Thames Foundry of the Ford Motor Co., Ltd., where Osborn automatic core blowers were also installed.

Jackmans, having represented Osborn in this country for more than 40 years, are able to offer American proved equipment of a wide range including the latest in automation in addition to their own wide range of manufacture. An export order for similar moulding machines was obtained from France and one for multiple station automatic core blowers for Russia.

The demand increased for combined shot blasting and de-coring equipment in foundries, dust filtration plant of the wet type, and a new system of fume removal from foundry shake-outs. The order book at the end of the year was well spread and the prospects are satisfactory, but it is not to be expected that the exceptional results of last year will be repeated in the current year.

As a result of the return to control of Mr. D. K. Bailey, as reported last year, the Howard Potteries Group's loss for 1956 was turned into a welcome profit for 1957. Increased orders are materializing from sales re-organization which now covers the whole of the British Isles. Export business is not easy and we must expect some delay before orders for North America resume their old level. Nevertheless, the order book is healthy and we hope for a greater increase in profit.

Last, but by no means least, we wish to record our sincere gratitude for the continued loyalty and diligence of all those throughout the varied group activities whose labours have achieved the successful year's results.

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By E. J. PRYOR, A.R.S.M., D.I.C., M.I.M.M.

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SIMMER AND JACK MINES, LIMITED

(Incorporated in the Union of South Africa)

FIRST REDUCTION OF CAPITAL
RETURN OF 6d. PER SHARE

Notice to Members of an Extraordinary General Meeting

NOTICE IS HEREBY GIVEN that an Extraordinary General Meeting of members of the Company will be held in Consolidated Gold Fields Building, **75**, Fox Street, Johannesburg, on Friday, 11th July, 1958, at 10 a.m., for the following purposes :—

To consider and, if deemed fit, to pass with or without modification and in the manner required by the Companies Act, 1926, as amended, for the passing of Special Resolutions, the following Resolution as a SPECIAL RESOLUTION, viz. :—

" THAT the capital of the Company be reduced from the sum of £843,750 (eight hundred and forty-three thousand seven hundred and fifty pounds) divided into 6,750,000 (six million seven hundred and fifty thousand) shares of 2s. 6d. (two shillings and sixpence) each, fully paid, to the sum of £675,000 (six hundred and seventy-five thousand pounds) divided into 6,750,000 (six million seven hundred and fifty thousand) shares of 2s. (two shillings) each, fully paid, and that such reduction be effected by returning to members paid-up capital which is in excess of the wants of the Company to the extent of 6d. (sixpence) per share on each of the aforesaid 6,750,000 shares ; and that the Chairman for the time being of the Company or any one of the Directors be authorized to apply to a competent Court for confirmation of the said reduction and to take all steps necessary to render it effective."

The reason for submitting this resolution to members is that the Directors have examined the financial position of the Company and consider that the present capital is surplus to requirements and in view of the uncertainty regarding the amount to be realized from the future disposal of assets are of the opinion that the time has now arrived when amounts realized from the disposal of assets as well as future working profits should be distributed to members in the form of capital repayments instead of in the form of dividends.

Such repayments of capital are free of taxation in the hands of most members whereas dividends are subject to taxation in the hands of some members.

Should the proposed reduction of capital be approved by members, a further circular will be issued when the result of the application to Court is known.

The Transfer Books and Register of Members of the Company will be closed from 7th to 11th July, 1958, both days inclusive.

A proxy form is enclosed for those members who wish to be represented at the meeting but are unable to attend in person.

A member entitled to attend and vote at the above meeting may appoint one or more proxies to attend and speak and, on a poll, vote in his stead. A proxy need not be a member.

By Order of the Board,
G. H. WARD,
London Secretary.

London Office :
49, Moorgate, E.C. 2.
10th June, 1958.

ROBINSON DEEP, LIMITED

(Incorporated in the Union of South Africa)

FIRST REDUCTION OF CAPITAL
RETURN OF 1s. 6d. PER SHARE

Notice to Members of an Extraordinary General Meeting

NOTICE IS HEREBY GIVEN that an Extraordinary General Meeting of members of the Company will be held in Consolidated Gold Fields Building, **75**, Fox Street, Johannesburg, on Friday, 11th July, 1958, at 9 a.m., for the following purposes :—

To consider and, if deemed fit, to pass with or without modification and in the manner required by the Companies Act, 1926, as amended, for the passing of Special Resolutions, the following Resolution as a SPECIAL RESOLUTION, viz. :—

" THAT the capital of the Company be reduced from the sum of £750,000 (seven hundred and fifty thousand pounds) divided into 2,000,000 (two million) " B " shares of 7s. 6d. (seven shillings and sixpence) each, fully paid, to the sum of £600,000 (six hundred thousand pounds) divided into 2,000,000 (two million) " B " shares of 6s. (six shillings) each, fully paid, and that such reduction be effected by returning to members paid-up capital which is in excess of the wants of the Company to the extent of 1s. 6d. (one shilling and sixpence) per share on each of the aforesaid 2,000,000 " B " shares ; and that the Chairman for the time being of the Company or any one of the Directors be authorized to apply to a competent Court for confirmation of the said reduction and to take all steps necessary to render it effective."

The reason for submitting this resolution to members is that the Directors have examined the financial position of the Company and consider that the present capital is surplus to requirements and in view of the uncertainty regarding the amount to be realized from the future disposal of assets are of the opinion that the time has now arrived when amounts realized from the disposal of assets as well as future working profits should be distributed to Members in the form of capital repayments instead of in the form of dividends.

Such repayments of capital are free of taxation in the hands of most members whereas dividends are subject to taxation in the hands of some members.

Should the proposed reduction of capital be approved by members, a further circular will be issued when the result of the application to Court is known.

The Transfer Books and Register of Members of the Company will be closed from 7th to 11th July, 1958, both days inclusive.

A proxy form is enclosed for those members who wish to be represented at the meeting but are unable to attend in person.

A member entitled to attend and vote at the above meeting may appoint one or more proxies to attend and speak and, on a poll, vote in his stead. A proxy need not be a member.

By Order of the Board,
G. H. WARD,
London Secretary.

London Office :
49, Moorgate, E.C. 2.
10th June, 1958.

RIETFONTEIN CONSOLIDATED MINES, LIMITED.

(*Incorporated in the Union of South Africa*)

FIRST REDUCTION OF CAPITAL
RETURN OF 1s. PER SHARE

Notice to Members of an Extraordinary General Meeting

NOTICE IS HEREBY GIVEN that an Extraordinary General Meeting of members of the Company will be held in Consolidated Gold Fields Building, 75, Fox Street, Johannesburg, on Friday, 11th July, 1958, at 11 a.m., for the following purposes :—

To consider and, if deemed fit, to pass with or without modification and in the manner required by the Companies Act, 1926, as amended, for the passing of Special Resolutions, the following Resolution as a SPECIAL RESOLUTION, viz. :—

"THAT the nominal capital of the Company be reduced from £312,500 (three hundred and twelve thousand five hundred pounds) divided into 1,250,000 (one million two hundred and fifty thousand) shares of 5s. (five shillings) each to £250,000 (two hundred and fifty thousand pounds) divided into 1,250,000 (one million two hundred and fifty thousand) shares of 4s. (four shillings) each and that the issued capital of the Company be reduced from £280,563 (two hundred and eighty thousand five hundred and sixty-three pounds) divided into 1,122,252 (one million one hundred and twenty-two thousand two hundred and fifty-two) shares of 5s. (five shillings) each, fully paid, to £224,450 8s. (two hundred and twenty-four thousand four hundred and fifty pounds eight shillings) divided into 1,122,252 (one million one hundred and twenty-two thousand two hundred and fifty-two) shares of 4s. (four shillings) each, fully paid, and that such reduction be effected by returning to members paid-up capital which is in excess of the wants of the Company to the extent of 1s. (one shilling) per share on each of the aforesaid 1,122,252 (one million one hundred and twenty-two thousand two hundred and fifty-two) shares which have been issued and by reducing the nominal amount of all the shares in the Company's capital from 5s. (five shillings) to 4s. (four shillings) each ; and that the Chairman for the time being of the Company or any one of the Directors be authorized to apply to a competent Court for confirmation of the said reduction and to take all steps necessary to render it effective."

The reason for submitting this resolution to members is that the Directors have examined the financial position of the Company and consider that the present capital is surplus to requirements and in view of the uncertainty regarding the amount to be realized from the future disposal of assets are of the opinion that the time has now arrived when amounts realized from the disposal of assets as well as future working profits should be distributed to members in the form of capital repayments instead of in the form of dividends.

Such repayments of capital are free of taxation in the hands of most members whereas dividends are subject to taxation in the hands of some members.

Should the proposed reduction of capital be approved by members, a further circular will be issued when the result of the application to Court is known.

The Transfer Books and Register of Members of the Company will be closed from 7th to 11th July, 1958, both days inclusive.

A proxy form is enclosed for those members who wish to be represented at the meeting but are unable to attend in person.

A member entitled to attend and vote at the above meeting may appoint one or more proxies to attend and speak and, on a poll, vote in his stead. A proxy need not be a member.

By Order of the Board,
G. H. WARD,
London Secretary.

London Office :
49, Moorgate, E.C. 2.
10th June, 1958.

THE CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LIMITED

Notice to Holders of 6% Convertible Unsecured Loan Stock, 1977–1982

Interest Payment No. 2

Warrants for the interest payable on 30th June, 1958, to Stockholders registered on 9th June, 1958, will be posted on 28th June, 1958.

Income Tax at the rate of 8s. 6d. in the £ will be deducted.

To facilitate payment of the Interest Warrants, the Stock Register of the Company will be closed from 23rd to 30th June, 1958, both days inclusive.

49, MOORGATE,
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14th May, 1958.

C. L. WATERHOUSE,
Secretary.

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Dividend No. 75 (Coupon No. 75)

NOTICE IS HEREBY GIVEN that an Interim Dividend (No. 75) of 1s. per share, less Income Tax at the rate of 8s. 6d. in the £ (equal to 6·9d. per share net), has this day been declared in respect of the year ending 30th June, 1958.

The Transfer Books will be closed from 17th to 19th June, 1958, both days inclusive, and the dividend will be paid on 25th July, 1958, to shareholders registered on 16th June, 1958, and to Holders of Coupon No. 75.

NOTICE IS ALSO HEREBY GIVEN to Holders of Share Warrants to Bearer of the Ordinary Shares of the Company that Coupon No. 75 will be paid in London by the Midland Bank Limited, New Issue Department, Poultry, E.C. 2, and in Paris by Lloyds Bank (Foreign) Limited, 43, Boulevard des Capucines, on and after 25th July, 1958.

Coupons must be left at either of the above addresses to permit of eight clear days for examination in London.

By Order of the Board,
C. L. WATERHOUSE, *Secretary.*

49, Moorgate, London, E.C. 2.
5th June, 1958.

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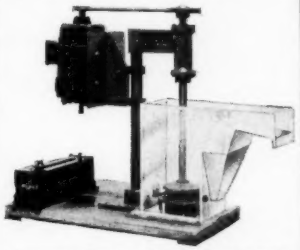

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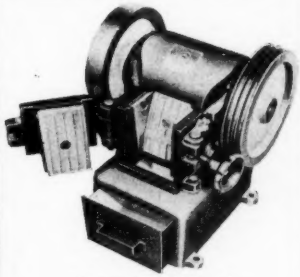

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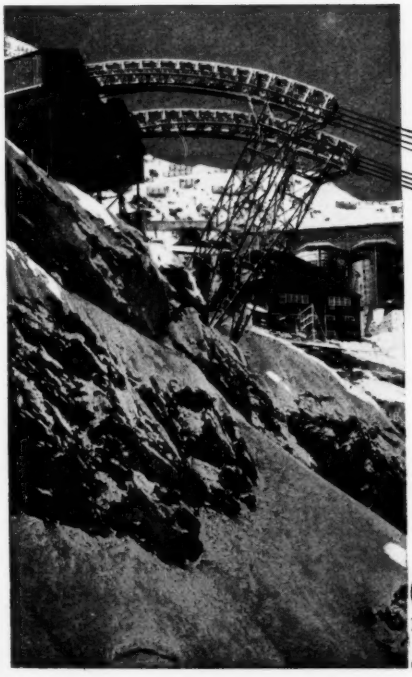

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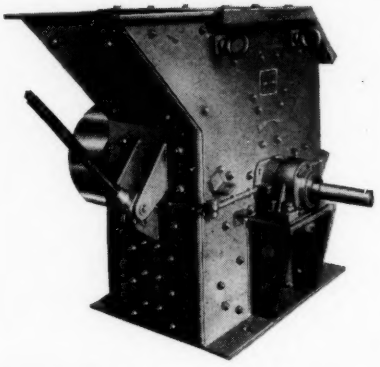

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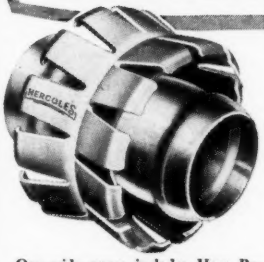

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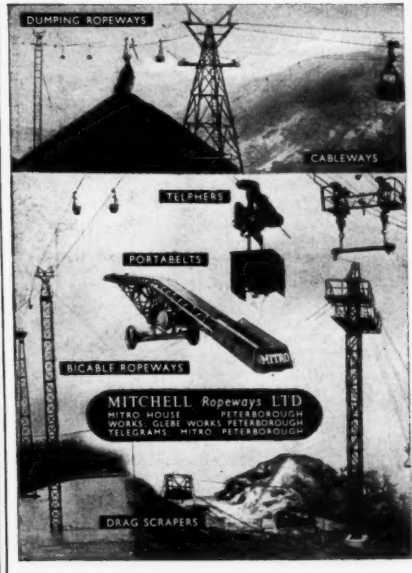

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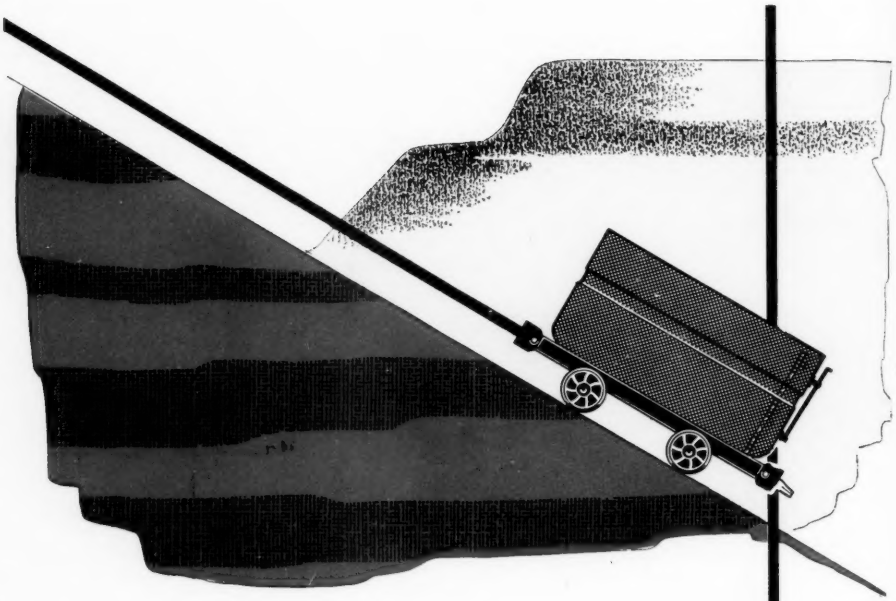

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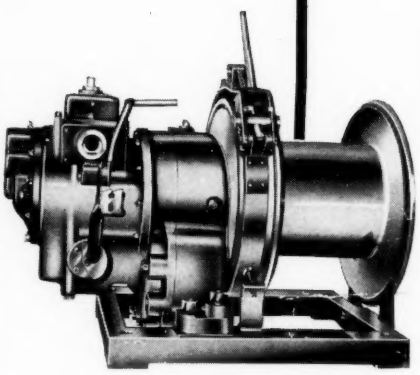

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